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(Continued from April number)

The following papers were read by title, on account of the authors being absent, and as the manuscript has been forwarded to the secretary they are included as a part of this report:

THE ORANGE WORM

(Trypeta ludens)

By PROF. A. L. HERRERA, *Chief of the Commission of Agricultural Parasitology, Mexico.*

This worm has been the object of long work tending to its destruction, said work being begun during the year 1900, when was established the Commission of Agricultural Parasitology, in the City of Mexico, which was especially intrusted with the work of combating the pest. The alarm among the Mexican orange growers was the result of the promulgation in California of a law whereby was forbidden the importation of the Mexican orange, without any distinction as to the place of origin, and under the supposition that every orange grown in Sonora, Nuevo Leon, Tamaulipas, and other states of the Mexican Republic, also contained the germ of a dangerous plague. Through the investigations and studies of the Commission of Agricultural Parasitology, it has been demonstrated that this pest exists only in the tropical parts of Mexico, particularly in the states of Guerrero and Morelos, and above all in Yautepec, where over 500 orange orchards are in full production.

As it was considered or thought that the pest was easy to be fought

and controlled, and that really it would present no danger in a cold or temperate country, the Mexican government invited Mr. J. Isaac, secretary of the Board of Horticulture of California, to come to Mexico during the month of March, 1905, and we accompanied him on several of his excursions. Afterwards, Mr. Isaac published a very important report (California State Horticultural Commission: Report of the Commissioner Appointed to Investigate the Prevalence of Trypeta ludens in Mexico. Districts Affected by the Orange Worm. Nature, Habits and Extension of the Pest. Methods Adopted for Its Control. Danger to be Apprehended from its Introduction, Etc. Sacramento, 1905, p. 1–48; Plates and Maps.)

The methods adopted to control this pest have been, lately, the subject of a report presented to this commission by Mr. W. W. Froggatt, commissioned by the British government to study the pests of the fruits, and who was in Mexico, coming from Australia, during the month of November of the present year. He visited Yautepec, the center of the pest and also of the work of the Commission of Agricultural Parasitology. According to Mr. Froggatt, the control work, conducted by this Commission, has been efficacious and within one or two years the pest will practically be of no moment.

It must be observed that every orange leaving Yautepec for Mexico or other parts, is carefully examined by skillful persons, well acquainted with the matter, and they confiscate every fruit having spots due to the sting of the ovipositor of the fly, or bearing any other sign of being attacked by worms. The examination is conducted at the railroad station or in the orchards. Thus is greatly lessened the danger of the worms infesting the orchards of other countries, provided the shipments come from Yautepec and not from other warm parts of Mexico.

In any case, however, the danger of infestation by this pest is rather problematical, since, according to my own observations, the fly remains completely inactive during the cold days; it is an insect of the tropics, and to be able to live and multiply it requires a medium temperature of at least 21 degrees. Once, it made a sporadic appearance in the temperate climate of Guanajuato in but one orchard. It lasted one year and was controlled. The following year a few flies appeared, but were not given time to multiply, being attacked by the same means. Since then, Mr. Dugès thinks the pest has never been seen any more. The same occurred in Zacatlan, in the State of Puebla. The flies were seen one year on pears but have not made any further appearance.

Lately the pest was thought to infest also the Mamey (*Mammea*

americana), but it has been found that it is another species (*Anastrepha serpentina*).

Means of control.—For the last seven years the pest has been combated, in Yautepec, by burning or burying the fallen fruit from the trees and cleaning of the orchards; the old wooden and thorny fences are replaced by wire fences; the orchards are carefully cultivated and the intercalar crops of sugar cane, "jicama," (*Dolichos*), etc., have been suppressed. One of the means that have been tried during these last months consists in injecting in the fallen fruits some gasoline or benzine, thus avoiding the transportation of heavy loads of oranges to the incinerating furnaces or burying ditches. These injections are performed by a workman who perforates the fallen oranges not yet rotten with a nail or any pointed tool, in but one place, so that the hole thus formed be of about the same diameter as a large pencil; then he squeezes the fruit in order to extract a large amount of its juice, and another man gives him an ear-syringe filled with gasoline or benzine, which is injected in a sufficient quantity, that is, all that may be contained inside of each orange.

The cost of this treatment is, approximately, from 15 to 20 dollars, Mexican money, for every 10,000 fruits. I think that this amount could easily be reduced if an automatic injector were used, which is not necessary for the present. According to practical informations from the agents of the commission, a workman may inject 250 oranges an hour, and therefore six workmen at work for eight hours a day will inject 12,000 oranges. The larvæ do not perish immediately, but they fall into lethargy under the effects of the vapors from the benzine, which slowly spread through the pulp of the orange and thus impede the exit of the larvæ already fully developed and ready to bury themselves.[1]

Parasites.—Since 1907 I have tried, very earnestly, to find the parasites which might help in the destruction of the fly. At first was discovered the *Cratospila rudibunda*, a species of wasp (*Braconidae*), which lays its eggs on the larvæ, through the skin of the guavas and mangos, but unfortunately its ovipositor is very short and could not penetrate to the interior of the oranges. This parasite could not be bred and besides is very scarce in Yautepec.

At Cuernavaca, a horticultural center of great importance, the guavas and mangos are infested by the *Trypeta ludens* and *acidusa*, but there are no orange groves in that place. With great care did I

[1]Mr. Froggatt says that in Australia they have been using petroleum with water to attract the flies, but the experiments made at Yautepec so far have given very little results.

look for the parasites on the fruit fallen under the trees; I found many articulates, which were classified by specialists of the Washington Bureau and they are the following ones:

A larva of *Elateridae*, belonging to *Melanotus* or some allied genus. As far as known, the larvæ of this genus live underground on the roots of various plants.

Stelidota geminata, *Epuraea labilis*. Both belong to the family *Nitidulidae*, or sap beetles, and are known to feed on decaying fruit and similar substances.

A Staphylinid beetle of the genus *Osorius*, the species being in all probability undescribed. This is certainly not injurious to fruit, the species of this genus living in the ground.

Larva of *Anastrepha (Trypeta) ludens* Loew.

A Curculionid larva, probably belonging to the genus *Conotrachelus*.

Species of this genus attack and injure healthy fruit, and an effort should be made, therefore, to breed the perfect beetle. This insect, however, was never found any more as injuring the fruit.

A Carabid larva belonging to the subfamily *Lebiinae*. The larvæ of this subfamily of *Carabidae* are predaceous.

Proctotrypes n. sp. Parasitic in larva of some insect.

A Staphylinid of the genus *Homalota*. The species of this and allied genera are certainly not injurious to the fruit.

A Coleopterous larva. (*Dermestidae*?)

Apharacta n. sp. Probably parasitic on *Anastrepha* or else on some Dipterous scavenger.

I have not tried to cultivate in vitro, the *Proctotrypes* or the *Apharacta*, because they seem to me of very little efficacy, even when they have the best climatic conditions, and moreover they are very scarce, and therefore the plague is causing great damages in the Cuernavaca fruit, where the orchardists are still more indifferent than at Yautepec, and do not pay any attention to the destruction of the fallen fruit.

I have made up my mind to keep up during the year the study of the parasites of *Trypeta ludens*, at the various stations. Neither did Mr. Froggatt find, at Yautepec, any important parasite of the orange worm, and as to the parasites recommended by Compère, and which he claims to have discovered in Brazil, they have been useless, according to the information of Mr. Froggatt and Mr. Lounsbury.

As to the *Hexamerocera brasiliensis*, advocated by Von Ihering, thus far it is not known whether it is efficacious.

To conclude, I will say that the danger of infection of the United States orchards does not appear to me as formidable as it has been claimed to be, owing to the difference in the climate, since it is a question of a tropical insect, and besides, though for the last 24 years worm infested oranges have been introduced into the United States, yet it is not known that the pest has appeared in any Florida or California orchard. Since 1884, the orange worm has been imported with the fruits proceeding from Mexico, and sold at New Orleans (Riley. "Insect Life," t. I, p. 45), a seaport which is not far away from the Florida orange groves.

Places in Mexico where oranges are produced abundantly, and are not infested by the Trypeta ludens.—Sonora, Aguascalientes, Chihuahua, Colima, Jalisco, Nuevo Leon, San Luis Potosi, Zacatecas. Most particularly, the orange from Autlan, Guarachita, Rio Verde, is never affected by the worm. It is but just, therefore, that not all of the oranges from Mexico be prohibited, rejected or subjected to examination. The Sonora and Jalisco fruit is extensively exported to the United States and this fruit is never wormy.

Mexico, December 7, 1907.

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[1] The above paper was accompanied by a large, admirably executed colored chart showing the pest in its various stages and also by many illustrations from John Isaac's special report, cited above, to which specially interested parties are referred.

A NEW ROOT PEST OF THE VINE IN CALIFORNIA

By H. J. QUAYLE, *Berkeley, Cal.*

In 1883 Matthew Cooke in his book, "Injurious Insects of the Orchard and Vineyard," gave an account of an insect attacking the grape vine in California which he called the Imported Grape Flea-beetle (*Adoxus vitis*). He confused this insect with the true flea beetle, and this mistake has continued in the accounts of the insect that have appeared in the literature of the state ever since.

It is now known that this insect is closely related to the grape root worm (*Fidia viticida* Walsh) of the eastern states and is improperly called a flea beetle. The life history, as it has been worked out during the past season, is briefly as follows: The beetles appear in May and June, when they feed on the growing parts of the vine above ground, including the leaves, tender shoots, petioles, pedicels, and even the berry itself.

The eggs are laid in clusters of four or five to fifteen or twenty on the stump of the vine beneath two or three layers of the old bark. From eight to twelve days are required for hatching and the young larvæ make their way to the roots, where they feed until the vine becomes dormant. By September some are about full grown, while others are but half grown. These latter resume feeding in the following spring. Pupation occurs within from four to eight inches of the surface of the ground during the latter half of April. The pupal stage lasts two weeks and the beetles begin emerging about May first.

Two forms of the beetle occur in about equal numbers in the state, one being wholly black, while the other has the elytra, tibiæ and basal half of the antennæ brown. These are known as *Adoxus vitis* and *Adoxus obscurus*, but they are undoubtedly simply two forms of the same species, since they are always found together and breed indiscriminately.

Adoxus vitis is a well-known pest of the grape in France and specimens received from there are identical with the brown form occurring here. Numerous specimens were sent me by Professor Valery Mayet of Montpelier, France, but only two specimens of *Adoxus obscurus*, which he states is very rare, and found only on a plant of the marshy prairies, and never upon the grape vine. The *obscurus*, as it is known in France, is apparently a distinct species, while what has been called *obscurus* in this state appears to be simply a form of *vitis*. Specimens from France and California have been submitted to Mr. A. E.

Schwarz of the Bureau of Entomology for determination, but his report has not been received at the present writing.

This insect has been known to occur in California for a good many years and its economic status has been based entirely on its leaf-feeding habits. This above ground injury to the vine, while it has been very great in some cases, is really unimportant as compared with the more serious and permanent injury to the roots. In some vineyards the crop has been reduced a third or a half and in one instance that came under our observation this year, two or three acres of vines were dug up on account of the injury to the roots by the larvæ of this insect.

APHIS GOSSYPII GLOV., AND ITS ALLIES—MEDICAGINIS KOCH, RUMICIS LINN., FORBESI WEED, OENOTHERIAE OEST., AND CARBO-COLOR GILL.

By C. P. GILLETTE,[1] *Fort Collins, Col.*

In my study of the *Aphididæ* of Colorado I have become convinced that there is still considerable confusion in the literature treating of the species having a close resemblance to *Aphis gossypii* Glover. I do not pretend to be able to straighten out all the crooked places, but hope to be able to offer observations and conclusions that will help to that end.

For several years past *Aphis gossypii* has done more harm than all other insect pests together to the canteloupe and melon vines grown in the Arkansas Valley in this state. In accord with the observations made by several other writers, the first appearance of the lice upon the vines takes place when the latter are just nicely beginning to run, but they seldom attract much attention until the vines are two feet or more in length. Once upon the vines, the lice increase with great rapidity. In our breeding cages Mr. Bragg has repeatedly reared new-born lice to the reproductive stage in eight days, and a common number of births per day has been from six to twelve. As a result the enemies,—parasites, ladybeetles and syrphus flies, finding an unstinted supply of food, also multiply rapidly and by about the second week of July often cause the lice to rapidly decrease in numbers and so save a large proportion of the melon crop. The lice continue upon the vines however to the time when killing frosts render the plants

[1] I wish especially to acknowledge the assistance of Mr. L. C. Bragg in accumulating the data for this paper.

no longer of service as food. During July winged individuals become very scarce, but the winged lice soon appear in considerable numbers and continue throughout the year.

Identification of Species

Aphis gossypii Glover.

Our observations upon this species continued for nearly a year before we were able confidently to separate it and *medicaginis* Koch. from each other and from closely related forms. Some of the distinguishing characteristics which later enabled us to do this are the following:

In *gossypii* the black appearing apterous females are really a very dark green; they nearly always have some light mottling upon the dorsum of the abdomen, due to the light colored embryos showing through, and these dark females are *never* highly polished.

Fully mature apterous females have antennæ and cornicles distinctly longer than in *medicaginis*.[2]

The larvæ of the first, second and third instars, especially of the winged form, nearly always show a distinct yellowish brown or pale salmon colored area upon the dorsal portion of the abdomen anterior to the cornicles and a conspicuous dark transverse band at the cornicles.

There is nearly always much variety of color in both the young and the adult apterous individuals, some being very dark, to the naked eye appearing black, and others with intergrading shades passing to very light yellow or tan colored viviparous females. The offspring of these light individuals may be as dark as the darkest through their entire life.

The pupæ are beautifully tessellated over the dorsum of the abdomen with silvery white.

So far as our observations have gone, *gossypii* has not been found colonized upon so large a range of food plants as *medicaginis*, which seems to be able to thrive upon almost any green thing.

Sexual forms and eggs we have been unable to find.

Aphis medicaginis Koch.

The fully adult apterous viviparous females of this species we have found, without exception, deep black and highly polished. They shine like glass beads among the other lice of the colonies and may be very few in number or entirely absent.

[2]Care must be taken not to mistake immature individuals, just before the last molt, for the fully mature form; they may be fully as large but they have very much shorter cornicles and antennæ.

The pupæ, while much resembling those of *gossypii*, do not have the tessellated dorsal spots so silvery white.

The young larval forms do not have the characteristic yellowish brown color of *gossypii* upon the dorsum of the abdomen nor the green transverse band, and there is not the range of light and dark forms among the apterous lice found in the colonies.

The tibiæ and basal half of the antennæ are more conspicuously whitish than in allied species.

This species has been specially partial to white sweet clover and *Glycerrhiza lepidota* here, two plants upon which we have never taken any of the allied species.

Sexual forms and eggs we have not been able to find.

Aphis rumicis Koch.

It seems almost certain that several writers, including Oestlund in his description,[3] have reported *medicaginis* as *rumicis*. I do not think that the *rumicis* of Linnæus has come under our observation, unless, possibly, it proves to be the same as *carbocolor* Gill.

Aphis carbocolor Gill.

This louse is somewhat larger and more robust than *medicaginis*, the adult apterous individuals are all deep dull sooty black, never polished, and it passes into the sexual forms in the fall, the females of which deposit eggs in great numbers about the crowns and bases of the leaves and stems of species of *Rumex*, especially the yellow dock. The cornicles are decidedly shorter and weaker than in *gossypii* or *medicaginis*. Winged viviparous females are shining black upon both thorax and abdomen. The seventh antennal joint and the antenna as a whole are longer than in *medicaginis*.

Aphis oenotheriæ Oest.

This louse has been considered a synonym of *gossypii* by Sanborn, which is probably a mistake as this is a green louse, occurring upon the primrose only, so far as we have observed, and never having the black apterous females of *medicaginis* nor the variety of colors exhibited by *gossypii*. It is possible that Prof. Sanborn had true *gossypii* from *Oenothera* and that he had not seen true *oenotheriæ*, which is a very common species in Colorado and quite distinct from *gossypii*.

Aphis forbesi Weed.

I would not include this species as belonging to the *gossypii* group were it not for the fact that it has been confused with *Aphis gossypii*

[3]Bull. 4, Synopsis of the Aphididæ of Minn. p. 61.

in a few instances. Prof. Sanderson[4] has already recognized it as a good species. We have not taken this louse in Colorado, but specimens that were sent me by Mr. J. J. Davis, State University, Urbana, Illinois, have been examined and prove to be easily distinguishable from any of the other species mentioned in this paper. In about three fourths of the examples examined, all of which were apterous females, the third and fourth joints of the antenna were united in one with no signs of a dividing suture. Dr. Weed in his description of this species describes it as having six-jointed antennæ. In the specimens having joints 3 and 4 separate, joint 3 but slightly exceeded joint 4, and the two joints together made one sub-equal in length with joint 7. In *gossypii* joint 3 alone is always longer than joint 7. *A. forbesi* is also smaller and is a root feeder.

Influence of Host Plant upon Aphid Characteristics

An impression seems to be more or less prevalent that a species of plant louse may vary much in structure and general appearance, depending upon the plant upon which it lives and draws its nourishment.

In all our experience transferring lice from one food plant to another and observing them upon widely varying plants in a state of nature or in hot-houses, we have never had any reason to think that a species is perceptibly changed in appearance because of a change of food plant. I am aware that there are migrating forms that are different in appearance from their immediate ancestors and that they may go to a different food plant, but in such cases the change came before migration or was "predestined" to appear in the first generation after migration. For example, the stem mother of *Phorodon humuli* upon the plum is quite different from the migrant that goes back to the hop[5], but the change came before deserting the plum. The oviparous female in the fall, which is the product of the return migrant from the hop, is very different from the migrant, but not at all because of its change in diet. It is the sexual female form of the species and what it develops into was determined in every case before the parent left the hop. Such changes as these, coincident with a change of food plant in the life histories of plant lice, can be duplicated many times over by instances where there is not a change of host plant. As familiar illustrations recall the remarkable variations

[4]Bull. 49, Del. Agr. Sta.

[5]I do not mean by this that the viviparous females upon the plum can be distinguished from the viviparous females upon the hop.

in the forms of *Phylloxera vastatrix,* which remains throughout life upon the grape, and of *Schizoneura lanigera,* remaining upon the apple, or of *Schizoneura americana,* without leaving the elm.

Do Aphis gossypii and medicaginis Lay Eggs?

Mr. Pergande mentions two instances where he thinks he may have discovered eggs of *gossypii,* but from his written statements it seems that he has not seen the sexual forms, and the probability of the eggs found being the eggs of *gossypii* does not appear to be very strong. For two years we have followed these lice closely without ever finding sexual forms or eggs at any time of the year. During 1906–'07 both these lice were followed all winter upon out-of-door plants by Mr. Bragg, and the present winter they have been followed into December, past several zero nights, and they are still in fine condition, but no males or oviparous females or eggs have been discovered. I would not dare express the opinion that sexual forms never appear in these species, but so far as our observations go, it seems very doubtful about their occurring in Colorado. We shall continue to search carefully for them.

Food Plants

As mentioned above, we have seen *Aphis oenotheriæ* upon the primroses only, and *A. carbocolor* has been taken by us upon no plants outside of the genus *Rumex.*

Aphis gossypii we have taken colonized from the cotton plant, canteloupe, muskmelon, watermelon, cucumber, winter squash, pumpkin, the native wild gourd (*Cucurbita foetidissima*), Shepherd's purse (*Bursa B-pastoris*) (which is its favorite plant upon which to spend the winter in Colorado), iron weed ([6]*Ambrosia trifida*), mare's tail ([6]*Erigeron canadensis*), *Rumex* sp. *Convolvulus* sp., *Lepidium virginicum,* [6]*Taraxicum dens-leonis,* [6]*Asclepias* sp., and in the summer upon the leaves of buckthorn (*Rhamnus cathartica*) and *Catalpa speciosa.* We have never found it upon strawberry or purslane, though looked for much upon these plants. Many of the other plants that have been named as the hosts for this species, and which have come under our observation in Colorado, we have found infested by colonies of *Aphis medicaginis.* I do not mean to say that I think the records that have been given for *gossypii* on these plants are incorrect, but simply state the results of our observations in Colorado.

The plants upon which we have observed *Aphis medicaginis* established and colonized are: White sweet clover, yellow sweet clover,

[6]Found on one plant only.

red clover, white clover, alfalfa, several species of native locos and lupines, wax beans, black locust, licorice (*Glycerrhiza lepidota*), apple, pear, plum, soft maple, boxelder, shepherd's purse (apparently its favorite over winter plant here), *Lepidium virginicum*, *Chenopodium* sp., *Rumex* sp., *Malvastrum coccineum*, primrose (*Anogra albicaulis*), Tansy mustard (*Sophia* sp.), dandelion and lawn grass (*Poa* sp.).

THE CATALPA BUD MAGGOT

By H. A. Gossard, *Wooster, Ohio*

For several years the tender growing twigs of catalpa have been attacked by insect larvæ, causing the twigs to become slightly swollen and to blacken and wilt at the terminal end. This trouble was so pronounced and excited so much complaint among the catalpa growers in various sections of Ohio, that the questions relating to it were referred to Mr. J. S. Houser for special investigation.

From an investigation made in the spring of 1907 of all the twigs on 15 three-year-old trees growing at Wooster, 49 per cent of them were found to have been damaged by this pest. Mr. Houser's description of the injury is as follows:

"The tender growing twigs of catalpa are attacked by maggots, causing the twig to become slightly swollen and to blacken at the point of injury. This occurs usually about three or four inches below the tip during the early part of the season, and at a lesser distance down later on when the twig is growing less rapidly. The twig above the injury dies. Following the death of the tip in early summer, the next node below develops one or more tips and frequently a cluster of leaves, giving the twig a bushy growth (Plate 1); following the later attacks the stem appears as in Plate 2, figure 1. The ultimate result after continued topping is a stunted, crooked, forked growth. (Plate 2, figure 2.)"

A large series of infested twigs were enclosed in breeding jars, the cuttings being sunk into moist earth. The specimens were collected at various periods of the growing season and through two summers. Though it seemed quite certain from some larvæ found in the affected terminals that a Cecidomyid would be obtained, it was not until the second summer that a midge was reared that seemed to agree with the description of *Cecidomyia catalpæ*, hitherto recorded as infesting the pods and destroying the seeds of catalpa. The few specimens obtained have been examined by Mr. Coquillett and Dr. Felt, and while both are agreed that the specimens are near *C. catalpæ*, they reserve

final decision until the specimens can be compared with Comstock's types.

Quite often, instead of midges, chalcids would appear in the cages. Mr. Crawford of the Bureau of Entomology pronounces these insects to be of a new species, belonging in a new genus, and he proposes to describe the species as *Zatropis catalpæ*. Whether the chalcids were present in the catalpæ shoots as parasites on the midge larvæ, or whether, like the wheat-joint worm and a few other members of the family, they are primarily injurious to vegetation, I cannot at present state. It is not impossible that the midges work on the tender leaves at the terminal end of the twigs, and that the chalcids insert their eggs in the soft wood lower down. Several specimens of the chalcid were obtained this season, all issuing between the middle of July and the middle of August. The three midges obtained emerged August 7, August 8 and September 3, respectively.

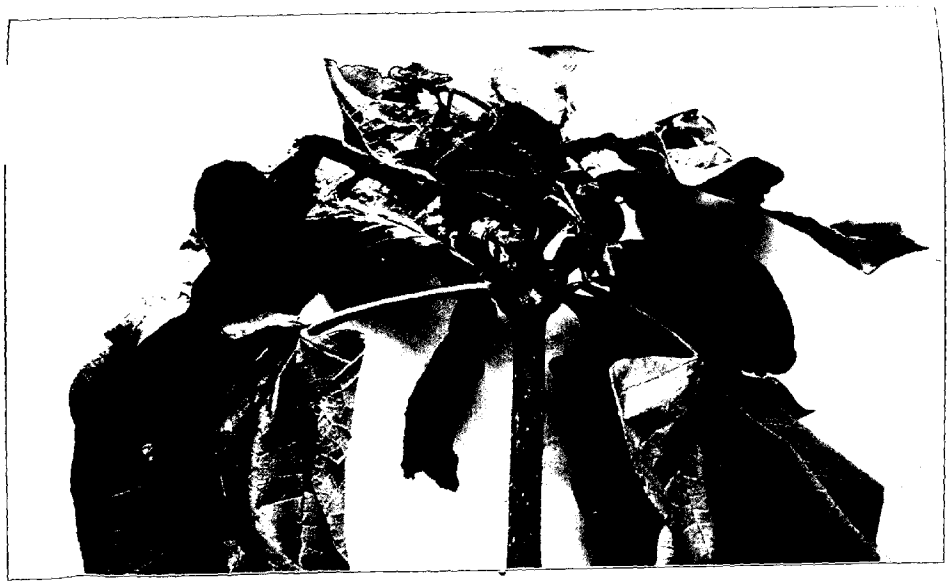
THE CALIFORNIA LIFE HISTORY OF THE GRAPE LEAF-HOPPER

Typhlocyba comes Say

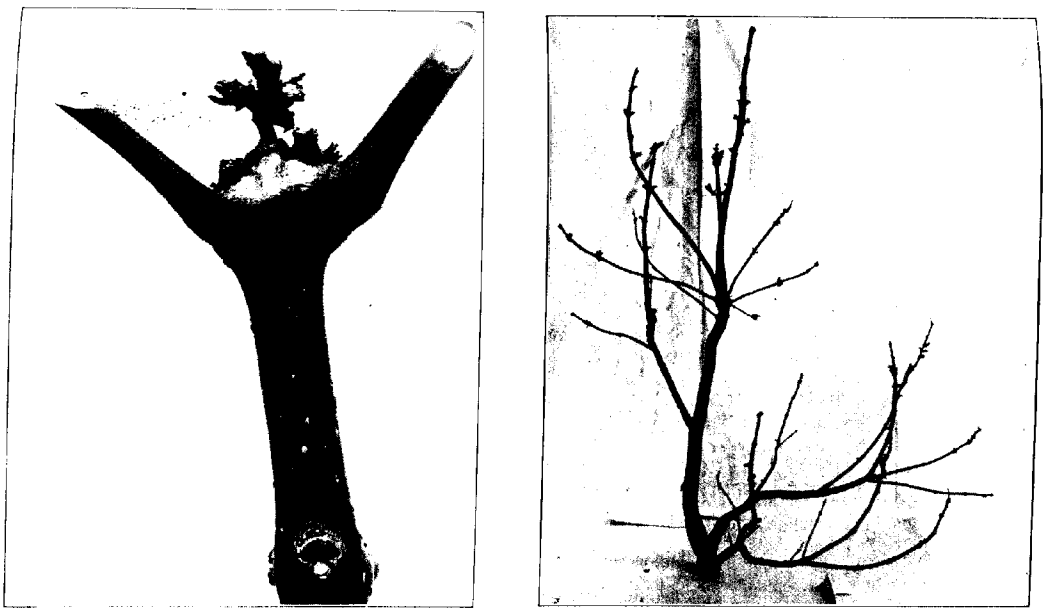
By H. J. Quayle, *Berkeley, Cal.*

Climate is a well-known factor in influencing the life history of insects, and so in California most, if not all, of our insects of economic importance have some points in their life-history that differ from those of the same species in the eastern states. Usually this difference is in the number of broods or length of the period of development, and less often a distinct variance in habits.

The grape leaf-hopper in California over-winters as an adult insect, feeding on a wide range of food plants during the warmer days; or remaining more or less dormant in bunches of leaves in the vineyard or low down in the dense vegetation of the bordering roadsides and fences during the cold or wet weather. As soon as the foliage appears on the vine in the spring they leave their varied winter food-plants and attack the grape exclusively. After feeding for about three weeks on the vine, pairing begins and eggs will be deposited one week later. This will be about May 1st in the lower Sacramento and San Joaquin valleys. Records were kept on twenty eggs from different hoppers and they required from seventeen to twenty days for incubation. Nymphs hatching from these eggs require on an average eighteen days to go through their five nymphal stages. The duration of each of the stages, summarized from observations on about fifty hoppers, is as



Work of Catalpa Bud Maggot
(After Houser, courtesy O. Agr. Expt. Sta.)



WORK OF CATALPA BUD MAGGOT
(After Houser, courtesy O. Agr. Expt. Sta.)

follows: First stage, four days; second stage, two days; third stage, three days; fourth stage, four days, and fifth stage, five days. Total, eighteen days.

The same insect in New York, as has been determined by Slingerland, requires from thirty to thirty-three days for its nymphal development. There is then a difference of two weeks in the time of development of the grape leaf-hopper in New York and that of the same insect in California. This difference is generally attributed to climate, although there is little difference between the climate of upper San Joaquin Valley in California in June and July and that of New York in the same months.

During the last week in June the hoppers, arising from the eggs of the over-wintering hoppers laid in May, begin egg laying, which is continued through July and a part of August. The incubation period was noted for a hundred or more eggs and they all hatched in from eight to twelve days. This is a shorter period than was required for the eggs to hatch in May from the over-wintering insects, and may be due to the difference in temperature.

A number of hoppers were confined in individual breeding cages on the leaves of the grape, and the number of eggs laid varied from forty to one hundred and twenty-one, distributed over a period of from three to seven weeks.

Hoppers hatching from these eggs remain on the vine until the leaves fall, when they attack their winter food plants, which include a large number of plants that may be growing in the vineyard or vicinity. These attack the vine in the spring, begin egg laying in May, and die off in July, making the length of the life cycle approximately one year. The spring brood hatching in May lives until about August or September, thus completing the life cycle in three or four months. There are thus two broods of the grape leaf-hopper in California, and, at least during the past year, there was no indication of a third brood.

NOTES OF THE SEASON

By H. A. Gossard, *Wooster, Ohio*

The season opened with a noteworthy weather condition that seems to have had a perceptible effect on the development of San José scale. March 19 the mercury rose to 68° at Wooster, and the following maximum temperatures were recorded at this place during the next two weeks:

March 19, 68°; 20, 67°; 21, 67°; 22, 82°; 23, 79°; 24, 74°; 25, 67°; 26, 70°; 27, 68°; 28, 67°; 29, 77°; 30, 67°; 31, 46°.

April 2, the mercury was down to 15°, and with the exception of seven nights, descended below freezing each night, until the 28th, when a warmer period commenced. However, the mercury dropped to the freezing point, or below it, nine nights in May, the last freezing record being on the 28th. Unfortunately, no direct observations were made which definitely proved this weather condition to have been adverse to the scale, but for some reason the scale has not been very much in evidence the past summer in many orchards that promised a year earlier to develop severe infestation in the normal course of events. Because of this phenomenon, I have not felt warranted in drawing conclusions regarding the effectiveness of one of the proprietary sprays which I undertook to test. The most plausible explanation occurring to me to account for this condition, is to suppose that the extended warm period in March started the dormant scales into activity, and that the cold freezing weather of April, following this warm period, proved fatal to them.

Some districts in which the scale has been controlled for three or four years with lime-sulphur spray, but were originally badly infested, are now seriously attacked and threatened with destruction by the bark borer, *Scolytus rugulosus*. I saw one orchard of young trees four or five years old which had never been very scaly, that was being badly attacked by these borers, which had migrated from a nearby apple orchard that had been destroyed by scale. This orchard seemed a good illustration of this insect's disposition to attack healthy trees when its numbers have outrun the supply of available weakened trees. As a trial application, I recommended to several correspondents to boil a thick lime-sulphur wash, using 20 pounds of sulphur and 30 pounds of lime, and add to each 50 gallons of this mixture 3 pounds of arsenate of lead (or 1 pound of paris green) and 6 to 10 pounds of fish-oil soap. This application was applied to the trunks and larger limbs with a spray pump or brush. Some of the parties who used it report seeming benefit, but I have not yet had an opportunity to make personal inspection of results, and shall not feel warranted in drawing any conclusions until the test is extended over several seasons. One orchardist painted the trunks and limbs of his trees in early spring with *Carbolineum arcuarius* and the benefit against the borers was apparent. I inspected the trees in early July and, at that date, no great amount of injury to the trees from the application was perceptible, the counterbalancing benefits seeming to entirely outweigh the attending damage.

The spring opened very late, so that the first spraying for codling moth fell about the first of June in northern Ohio. This period was very wet and quite cool. For test work, I made use of a ten-acre orchard located about ten miles from the shore of Lake Erie, and hence not damaged much by frost. One half of this orchard consisted of Baldwins and the other half of Ben Davis. I tested the coarse, driving spray, as used in the western arid states, by enlarging the orifices in Vermorel nozzles, and also used the medium caps for comparison. Three pounds of arsenate of lead were used in 50 gallons of Bordeaux—the Bordeaux formula being 3 pounds of copper sulphate and 6 pounds of lime. The trees averaged 20 feet, or more, in height, and had a corresponding spread of top. One plot was treated with one third pound of paris green to 50 gallons of Bordeaux. About one gallon of soft home-made soap was added to each 50 gallons of spray for most of the plots. One plot had 2 pounds of copper sulphate and 1 pound of iron sulphate instead of the regular Bordeaux formula. About 100 pounds pressure was maintained by the pump. For the purpose of better directing the spray, two small pieces of three-fourths inch gaspipe, about 4 inches long, were threaded at each end, and after being bent about 25 or 30 degrees from the horizontal, one was attached to the end of each rod by means of a gas coupling, and the nozzles were then attached to the bent pipes. The spray was directed downward and inward and was used until the trees dripped. On trees 20 to 25 feet high, with corresponding spread of top, from 7 to 8 gallons of spray were used. The second spraying was made about 10 days after the first, and in the same proportions, only the copper sulphate was reduced to 2 pounds for 50 gallons of spray. Not more than one half as much spray was used in this application as in the first spraying. The third spraying was given to part of the orchard about the middle of July. Arsenate of lead alone was used for the July application, the Bordeaux being omitted. Not more than three or four gallons of spray were used on the largest trees for this application. As the full results of the test will soon appear as a Station publication, I will not enter into further details, but state results and conclusions. Over 90% of the apples on trees sprayed three times were free from worms. A record was kept of the dropped apples under certain trees beginning with the 30th of July. The following are one of the figures:

One tree sprayed twice, once just after blooming and again ten days later, has the following record: Sound apples dropped from the middle of July until harvest, 319; wormy drops from middle of July until harvest, 23; drops marked by curculio during the season, 8;

sound apples picked for harvest, 4,477; wormy apples picked for harvest, 14; marked by curculio at harvest picking, 21. Thus 98.67% were untouched by either codling worm or curculio; 99.25% were untouched by codling worm, and 99.69% were free from codling worm at harvest time. An unsprayed check tree, with a far better record than some others for sound fruit, yielded at the harvest 1,670 sound apples, 347 wormy ones, and 210 marked by curculio. Some of the wormy apples were also marked by curculio, which are not shown in this enumeration. Since the middle of July, this tree dropped 221 sound apples, 339 wormy ones and 48 marked by curculio. The season's yield, drops and harvest, gave 25.62% damaged by codling worm and curculio combined; 19% by codling worm alone, and 20.77% were wormy at picking time.

I decided that ordinary Vermorel nozzles with medium caps gave the best spray at 100 pounds pressure, and that the little crooks were of decided advantage in directing the spray; that three sprayings gave better results than two; that the first application just after blooming should be heavy to secure immunity from worm attack; that in cold, wet seasons, such as the past spring, considerable russeting follows a heavy spraying; that less russeting occurs on fruit sprayed when it is a week or ten days old than when it is younger; that russeting would probably be reduced by omitting Bordeaux from the first application, using instead arsenate of lead with lime added, but this question needs further testing; that an application for the second brood should be made by July 15th, or earlier in northern Ohio; that soap, or other stickers, do not appreciably enhance the value of these sprays when used on apples; that at least one pound of iron sulphate can replace one pound of copper sulphate in a 3–6–50 Bordeaux formula without injury to foliage or fruit, but I have not yet decided as to whether this mixture is an improvement on the ordinary Bordeaux.

The variegated cutworm, *Peridroma saucia*, was quite destructive in some localities, and if conditions are not unfavorable for its development, it will probably do a large amount of damage the coming year, for it is very plentiful over all northern Ohio. It attracted special notice at Sandusky, where it had attacked gardens, lawns and greenhouse products.

The radish maggott, *Pegomyia brassicæ*, was not so destructive as in some former years. I have not made very satisfactory progress against this pest, though I have, through two seasons, tried about all the known remedies. Mr. Geo. E. Hartung of Sandusky, a market gardener, who has suffered much from the insect in former years, reports practically no injury this season, and believes his immunity was

ecured by overhead irrigation, since his neighbors suffered as in ther years. Mr. Hartung's pipes are about 8 feet above the ground, 6 feet apart and the jets from the pipes are 4 feet apart. This re-ult, and the attendant benefits of irrigation, seem to make this treat-nent worthy of testing by large market gardeners. For the ordinary itchen garden, the most satisfactory treatment tried by me, from the iew-point of good, healthy radishes, reasonably free from maggots, vas a liberal application of tobacco dust every five or six days during he growing period, commencing as soon as the plants were through he ground.

The Hessian fly has dropped so nearly out of sight that careful search must be made to find it at all. I have not observed the chinch bug and only one or two correspondents have referred to it during the season. The wheat joint-worm has also decreased in numbers, not having been the subject of one half as many inquiries as were received regarding it last year.

The grape-berry worm has decreased considerably in the grape region along the lakes, but has become more injurious in the interior sections where the small, home vineyards are found. I repeated the experiments recorded in Circular 63, getting practically the same results. We used a traction sprayer fitted with 10 nozzles and throwing about 170 gallons of spray per acre. A double application with this machine—the Wallace—was very nearly equal to thorough hand work. A check row that was sprayed three times with Bordeaux, containing no poison, had 58% of the berries wormy and yielded marketable fruit at the rate of 1,798 pounds per acre. One-half of this check row was sprayed during the latter part of July by hand, with arsenate of lead in Bordeaux, with a resin soap sticker added, and this half of the row had 2.9% of wormy berries and yielded marketable grapes at the rate of 5,608 pounds per acre. This plot had the lowest percentage of wormy berries of any in the tests, but lost too many young grapes in the early part of the season to equal in total harvest some of the plots that received earlier applications of poison. This plot proved, however, that the late July spraying is the most important of all, and that the later broods of the worm must be killed or comparatively little benefit will be derived from the earlier applications. This result is a repetition of the experience of last season regarding late spraying. A plot, hand-sprayed three times with Bordeaux, arsenate of lead, and resin soap sticker, had 3% of wormy berries and yielded at the rate of 6,031 pounds of marketable grapes per acre. The grapes of this plot had too much spray adhering to them at harvest time, and it will be necessary to sacrifice some grapes

rather than to send them to market in this condition. A plot sprayed three times with the same ingredients, by the double machine plan, had 4.47% of wormy berries and yielded 6,067 pounds of marketable grapes per acre. Three sprayings of Bordeaux, with arsenate of lead and resin soap added to the second and third applications, double machine plan, gave 4.8% wormy berries and harvested 3,864 pounds of marketable grapes per acre. The same ingredients applied at the same time as in the preceding case, but with single machine instead of double machine application, gave 20.34% wormy berries and harvested 3,465 pounds of marketable grapes per acre.

The double machine applications, if made three times with soap stickers, gave almost as good results as hand sprayed plots and were more presentable for market. It is quite conceivable, however, that if little rain were to fall in late summer, grapes treated in this way might carry too much spray to be presentable in appearance or safe to use in large quantities at harvest time. One plot was treated with a Bordeaux made of 4½ pounds of copper sulphate, 3 pounds of iron sulphate and 6 pounds of lime, with 3 pounds of arsenate of lead added. This made a spray that had good sticking qualities and yet washed off quite readily by rain. Three sprayings, double machine application, with this mixture, gave 10.18% wormy berries and 5.760 pounds of marketable grapes per acre. This treatment seemed quite satisfactory for the fruit, but threatened to eat the galvanizing from the iron wires supporting the vines, thus shortening their durability by more than half. Parasites are appearing freely over the infested vineyards and doubtless are contributing to the suppression of the worm.

The greenhouse white fly has become established in many greenhouses and we have a good many inquiries regarding the process of fumigation with hydrocyanic acid gas. The fall webworm was abundant last year, but has been much more numerous the present season. Park superintendents and many orchardists have been obliged to wage systematic warfare against it the past summer. The black walnut caterpillar, *Datana integerrima*, has been numerous for two seasons, and many trees are threatened with destruction by it, having been completely defoliated for two years in succession. The white-marked tussock moth has been extremely abundant in city parks and was the subject of many inquiries. *Pimpla inquisitor* has become numerous at Dayton, according to local observers, and the suppression of the tussock worms is expected in that city in a short time. The terrapin scale, *Eulecanium nigrofasciatum*, has been our most serious scale insect on maple trees for the past two seasons. The remedies usually recommended for this scale—namely kerosene emulsion and the lime-

sulphur wash in winter—have not given very good results where tried by the Station.

A rather extensive test against the peach borer was tried in a young orchard, but partially failed to yield results because of the scarcity of borers, even on the check trees, and of course full returns cannot be had until spring. I decided, however, that the use of building paper, or other protectors of like character around the trees for a period sufficiently long to be of effectual use in preventing egg-laying, was more undesirable than injury by the borers, while various sticky and poisonous mixtures were of questionable utility. Mounding with earth seemed among the best remedies, but by all odds the most satisfactory treatment from the standpoint of the trees and borers combined, was tying tobacco stems loosely about the base of the trunk, and suspending them from a point about twelve or fifteen inches above the ground. Prof. Slingerland gave a very good report of this treatment several years ago, but did not specially emphasize the splendid tonic effect it exercises on the trees. This treatment seemed to more than pay for itself without any reference to the presence of borers, while at the same time it possessed good value in this respect.

In 1906 I took advantage of the proffered services of Mr. C. F. Harbison of Dayton, O., to conduct a coöperative experiment against the elm leaf-beetle. Acting under my instructions, Mr. Harbison banded some elm trees in early June with Thum's Tree Tanglefoot to prevent the larvæ reaching the ground when descending to pupate. Immediately above this sticky band was arranged a burlap band, beneath which the insects could shelter and pupate. The first count of the catch was made June 17, and showed 200 insects in the Tanglefoot band, 124 beneath the burlap and 72, which had been dislodged, at the base of the tree and were unable to re-ascend. This made 396 in total.

A second examination made June 21, collected 417; a third, 599, and a fourth, 422, making 1,834 beetles, pupæ and larvæ taken from one tree.

About July 24th, eight trees were banded and the totals taken during the four examinations amounted to 16,122 insects in various stages, mostly larvæ and pupæ. The number under the burlap band that had pupated kept constantly increasing at each examination, indicating the importance of the burlap in connection with the Tanglefoot. The same experiment was repeated the past year and Mr. Harbison reports a collection of 4,938 insects from three trees on the 9th of August; again, on August 13th, 8,491 insects from four trees; and on August 22d, 4,653 insects from three trees, making 18,082 insects from ten trees. I do not understand from the report whether the bands

were put on all of these trees on the same date or not, but this is my inference. Mischievous persons, presumably boys, removed the bands before further examinations could be made, but we regard this method of fighting the insect as proved to be cheap and effective.

A Millipede, one of the *Polydesmidæ*, became very numerous in the Station greenhouse this fall, occurring by tens of thousands in a bed devoted to forcing cucumbers. A few vines were killed before the insects attracted notice. The men in charge used a plentiful supply of tobacco dust as a mulch about the bases of the vines, and also mixed more or less of the dust in the soil, with the result that hundreds of dead worms could be found at the base of each vine a few days after the application was made, and tens of thousands of them dropped from the beds to the stone floor beneath, where they died. This remedy was a speedy and complete success.

In my bulletin on insecticides, published by the Florida station, I mentioned the use of powdered cyanide of potassium for ants, in cases where carbon bisulphide could not be conveniently used. This has been used so successfully by some parties to whom I have recommended it the past summer, that I think it worth while to emphasize the value of the treatment. The crushed cyanide must not come in contact with plant tissues, but should be sprinkled on the soil where the ants congregate, or have their nests. The ants either leave at once or attempt to remove the obnoxious particles, only to die in the attempt. The cyanide, if used in moderation, will act as a fertilizer for the plant and benefit instead of harming the same.

The Rosebug was abundant at Wooster, as has been the case for the past three seasons, and the vilest sprays do but little good against it. I have succeeded in driving them away for a day or two by spraying with Bordeaux mixture, to which was added arsenate of lead, fish-oil soap and crude carbolic acid, but they were always ready to return after a few hours' interval. The larger the area sprayed, the less heed do they seem to give the treatment. I found it practicable to fence them out from a few blooming grapevines with a covering of mosquito bar, and also that they could be prevented from accumulating and doing any great amount of injury by picking them by hand three times a day through a two weeks' period. Though the latter method was only tried on a small scale, I am inclined to think it would pay in commercial vineyards of small size, at least in seasons where fruit is as high priced as at present.

During the spring, wheat and oats over Ohio suffered from a peculiar disease, marked by a reddening, yellowing and browning of the leaves, and a general stunting of the growth and retardation of the

development in all respects. From the fact that the grain louse, *Macrosiphum granaria*, was noticed in considerable numbers in some fields, the newspapers and many correspondents attributed the damage to the lice. Others suspected thrips of causing the mischief. After an examination which I deemed adequate, I concluded that neither of these insects was primarily responsible for the disease so far as Ohio was concerned, though both species added to the trouble to a considerable degree in some fields. The majority of the diseased plants, however, were damaged but little by either insect, and many of them not at all, so far as I could determine. Corn, clover, alfalfa, strawberries and many weeds suffered in precisely the same way, as inferred from their external symptoms, and no insects whatever could be found upon them. I decided the trouble was probably wholly physiological in character, and was in all likelihood caused by the cold, wet spring. Parasites overtook the lice in most localities before they became excessively plentiful.

THE HONEY AND POLLEN-YIELDING PLANTS OF TEXAS.

By A. F. Conradi, *Clemson College, S. C.*

Triple-leafed Barberry. (*Berberis trifoliata* Morie.) On gravelly hills from the Gulf coast to the Limpia mountains. Yields honey abundantly, also pollen. Blooms January and February and is important for early brood rearing.

Prickly Poppy. (*Argemone platyceras* Link and Otto.) Abundant along roadsides, in waste fields and on prairies. Honey yield unimportant, but yields abundant pollen during dearth of summer. In the Brazos River Valley bees work heavily on it during June. The orange-colored pollen is carried to the hive, making the combs look disagreeable. May to July.

Poppy. (*Papaver rhoas* L.) Honey yield unimportant owing to scarcity of plants. May.

Pepper wort. Pepper grass. (*Lepidium virginicum* L.) Widely distributed. Yields small quantities of honey and pollen.

Greggia. (*Greggia camporum* Gray.) Confined largely to west Texas. Blooms near San Antonio in February. Yields some honey, but pollen is important for early brood rearing.

Turnip. (*Brassica rapa* L.) Yields honey and pollen.

Black mustard. (*Brassica nigra* (L.) Koch.) Scatteringly throughout Texas. Bees work on it busily, but its status as a bee forage plant has not been determined. June and July.

Portulaca grandiflora Hook. Grown in experimental plats at College Station. Honey yield good owing to the extended blooming period from June till frost. Pollen is highly colored.

Salt cedar. (*Tamarix gallica* L.) Common in the Gulf coast country. Several trees cultivated at College Station bloom from May to June.

Fringed Poppy-mallow. (*Callirhoe digitata* Nutt.) A common plant yielding honey and pollen in small quantities. An excellent pollen plant at College Station.

Spanish Apple. (*Malvaviscus drummondii* Torr. and Gray.) Common along the Comal and Guadalupe rivers near New Braunfels. Bees visit it, but in that section is not an important honey plant.

Shrubby althea. (*Hibiscus syriacus* L.) An ornamental plant in parks and gardens. Bees work busily on it, but the plants are few. Yields honey and pollen; blooms from May and June to fall.

Sida spinosa L. A common plant blooming during the summer. Honey and pollen yield light, but valuable during dearth.

Sida angustifolia Lam. In dry soils throughout southern Texas blooming from spring to fall. Yields honey and pollen.

Cotton. (*Gossypium herbaceum* L.) Yielding a strong steady flow of white honey during the entire blooming period from June to frost. The main source of honey throughout the cotton section. The honey is furnished by nectar glands of leaves, bracts, blossoms and bolls.

American linden. (*Tilia americana* L.) Occurs sparingly throughout Texas as far west as San Antonio. A heavy yielder of fine honey.

Large-flowered caltrop. (*Tribulus cistoides* L.) Mr. L. Scholl reports this plant from Hunter as a good honey and pollen yielder, but flowers close at noon. April to August.

Greater Caltrop. (*Kallstræmia maxima* (L.) T. and G.) Common throughout southern and western Texas; a good honey and pollen plant in time of dearth.

Yellow wood sorrel. (*Oxalis stricta* L.) In open woodlands throughout Texas, blooming during summer, but not abundant enough to be important bee forage.

Prickly ash. (*Xanthoxylon clava-hercules* L.) Known as toothache tree and sea-ash. A common shrub in woodland prairies, blooming April 15 to June. A good honey and pollen plant.

Hop tree. (*Ptelia trifoliata* L.) In low woodlands throughout southern and western Texas. Where abundant the plant is a good honey yielder during favorable seasons. May to July.

Hardy orange. (*Citrus trifoliata* L.) Until recently this plant

has been scarce in Texas, having been planted principally for hedges. With the development of the citrus industry the demand for hardy deciduous stock to enable the commercial orange tree to withstand a lower temperature has caused a rapid increase of this species. It blooms March 15 to 25; during this time bees work on it busily, obtaining a fair quantity of honey for early brood rearing.

Tree of Heaven. (*Ailanthus glandulosa* Desf.) This is recorded from Hunter as follows: Cultivated for shade. Honey yield fair in good seasons, also pollen. There are also nectar glands on leaf blades. April.

Umbrella china tree. (*Melia azedarach* L.) A common shade tree in central and southern Texas. It yields honey which helps early brood rearing in February and March.

Possum Haw. (*Ilex decidua* Walt.) Also known as Youpon and Bearberry. Lowlands in southern and central Texas west to the semi-arid country. Blooms between March and May. Valuable for early brood rearing.

Youpon. (*Ilex caroliniana* Trelease.) Southern Texas westward to San Antonio. March and April, helping early brood.

Brazil wood, Log wood. (*Condalia arborata* Hook.) Central and western Texas. A good honey plant at College Station; some pollen. July and August.

Colubrina texensis Gray. On dry soils from the Colorado River west and south. Honey yield good; some pollen. Plants too scarce for surplus. April.

Rattan vine. (*Berchemia scandens* Trelease.) Along ravines and in lowlands; blooms April 15 to 25, giving a good surplus in favorable seasons, but the honey is dark amber.

Common grape vines. Good for pollen. April.

Mountain grape. (*Vitis monticola* Buckley.) Hilly limestone regions of western Texas. Honey yield fair; pollen valuable for early brood rearing. March.

Cow itch. (*Cissus incisa* Desmoul.) On uncultivated ground from the Colorado River westward. April to August, yielding surplus where plentiful.

Soap berry. Wild china. (*Sapindus marginatus* Willd.) Creek bottoms throughout southern and western Texas. An evergreen shrub, blooming in April and May, yielding heavy surplus where the plants are abundant.

Balloon vine. (*Cardiospermum halicacabum* L.) Throughout central, southern and western Texas. Honey yield good, but plants are scarce.

Mexican buckeye. (*Ungnadia speciosa* Endl.) In mountainous woodlands and on rocky hillsides throughout southern, central and western Texas. Honey yield important as it blooms during July dearth, but the plants are not plentiful.

Green Sumach. (*Rhus viviens* Lindh.) In rocky country west of Colorado River. Bees work on it during dearth. Blooms as late as October.

Rhus sp. A small shrubby tree on rocky hillsides and on woodland prairies. Bee-keepers report it a good honey plant, giving surplus in favorable seasons, depending upon rains. August.

Blue bonnet. (*Lupinus subcarnosus* Hook.) Southern, central and western Texas on prairies and on open woodlands. The honey and pollen yield is good; the pollen is of a bright orange color. March and April.

Red clover. (*Trifolium pratense* L.) An attempt was made to grow red clover with a view of determining the ability of the five races of bees to secure honey, notwithstanding the deep corollas. We have no evidence that any of the strains of bees are able to obtain honey, while the plants did not prosper owing to the dry climate.

Alfalfa. (*Medicago sativa* L.) Is extensively cultivated for hay in humid and semi-arid Texas. We know that it is a valuable honey plant in irrigated sections of Colorado and New Mexico, but there is considerable difference of opinion as to its value in unirrigated sections of Texas. In the great honey belt of southwest Texas it appears to be no preferred plant. We have a note on record from Mr. E. Scholl, formerly assistant to the writer, when State Entomologist of Texas, which states that large numbers of bees were seen on alfalfa at New Braunfels during June, 1907. During his work as deputy foul brood inspector he reports alfalfa "a good thing" in north Texas. In the Brazos River bottom where bees were near alfalfa we were unable to ascertain the importance of alfalfa as a honey plant because bees preferred other blossoms occurring during alfalfa bloom. Where bees work on it, the honey yield is fair during early summer and fall. On July 12 Mr. Will Atchley, one of the most successful apiculturists of Texas, presented the writer with a jar of alfalfa honey from Beeville, the quality of which was fully equal to the Colorado product.

Medick, Burr clover. (*Medicago denticulata* Willd.) Abundant at College Station during spring. While it yields honey sparingly during early summer, it comes into bloom at a time when honey flora is scarce, and when bees must depend on honey gathered from mis-

cellaneous sources. It disappears with the approach of hot weather and the advance of Bermuda grass.

White sweet clover. (*Melilotus alba* Seso.) Sparingly scattered along railroad tracks and in waste places. It is a good yielder of a fine quality of honey. The plants cultivated in the experimental plats at the A. & M. apiary are doing well each season. Seeds scattered broadcast in waste grounds germinated well, but the young plants were seriously handicapped by the ever-present and persistent Bermuda grass. Mr. C. S. Phillips of Waco, Texas, stated to the writer that sweet clover sown by him along the H. & T. C. Railroad near Waco appeared to hold its own. The plants bloom from June to fall. Owing to its honey yield white sweet clover should be sown for honey producing purposes. It grows in soils containing lime and although cattle treat it with skepticism when first introduced to it, owing to the characteristic odor, they soon learn to eat it. In cultivated land and where Bermuda grass is absent the plant prospers. No doubt every bee-keeper could utilize it to supplement the honey flow during a season of dearth. The writer has observed this plant in several latitudes between the Rio Grande River and northern New England where "bees roared on it."

Yellow sweet clover. (*Melilotus officinalis* (L.) Lam). Occurs sparingly, escaped. Bee-men contend that yellow sweet clover is earlier and superior to white sweet clover. It should be cultivated on waste lands and the poorer soils. May to fall.

Eysenhardtia. (*Eysenhardtia amorphoides* H. B. K.) Also known as rock brush. On light soils of woodlands and open prairies throughout southern and western Texas. Yields abundant honey of a fine quality. March to May after heavy rains.

Black locust. (*Robinia pseudacacia* L.) Cultivated occasionally on lawns. During March and April the bees work on it abundantly, obtaining a fair quantity of honey, provided the weather is not too cold.

Mexican ground plum. (*Astragalus americanus* A. D. C.) Open prairies of Texas, yielding honey abundantly, principally during June. It is injured by drouth.

White clover. (*Trifolium repens* L.) Sparingly on roadsides and lawns. It is well known as one of the main sources in states north of Texas. Several attempts to grow it at College Station proved failures owing to dry climate.

Cow pea. (*Vigna* sp.) Cultivated for forage and soil improvement. July and August. Yields a good quantity of light-colored honey of fair quality. It is one of the plants utilized at the experi-

mental apiary for bridging the bees from spring flora to horse mint and cotton, but the repeated cold waves during the spring of 1907 severely handicapped its honey yielding power.

Neptunia. (*Neptunia lutea* Benth.) Sparingly, eastern and southern Texas along the Rio Grande as far north as Laredo. Pollen during May.

Red bud, Judas tree. (*Cercis canadensis* L.) Our only honey-producing records are from Comal County, where it blooms from March 1 to April 15. Good honey plant, helping early brood.

Sensitive briar. (*Schrankia angustata* Torr. and Gray.) Open prairies west of San Antonio. Honey yield not important owing to the scarcity of the plant, yielding pollen. April to September.

Cassia. (*Cassia longifolia* Car.) In damp sandy places; visited frequently by bees.

Mesquite, Screw bean. (*Prosopis juliflora* D. C.) Widely distributed in southern and western Texas. While occurring sparingly everywhere in Texas, the mesquite belt proper extends from the Rio Grande River north to the northern tier of counties of the Pan Handle, between 98 and 101 meridians, and along the valleys of the Rio Grande, Pecos and Canadian rivers. Main source in State. Honey light colored. April and again in June.

Honey locust. (*Gleditchia triacanthos* L.) Sparingly wild and in cultivation. Heavy yielder at College Station, but bloom extends from April 15 to 25 only.

Garden pea. (*Pisum sativum* L.) Yields some honey and pollen.

Retama. (*Parkinsonia aculeata* L.) Low sandy soils, southern and western Texas. May to September. Valuable in dearth.

Albizzia. (*Albizzia julibrissin* Durazz.) On campus, College Station; honey yield fair. May to July. Long stamens handicap bees.

Huajilla, "Wahea." (*Acacia berlandieri* Benth.) Solid masses on dry and rocky hills from the Nueces to the Rio Grande and Devils rivers; at its best in Uvalde and adjoining counties. Heavy honey yielder; best honey in State and main surplus in southwest Texas.

Cat claw. (*Acacia gregii* Gray.) Also known as devil's claw and Paradise flower. On dry, rocky soil throughout southwest Texas. One of the main yielders of fine honey. April and again in June.

Texas cat claw. (*Acacia wrightii* Benth.) Throughout southwest Texas; one of the main yielders of fine honey. April.

Round-flowered cat claw. (*Acacia roemeriana* Schlecht.) Widely distributed over southwest Texas, yielding a heavy flow of fine honey during April and May. Less abundant than preceding species.

Acacia. (*Acacia amentaceae* D. C.) Abundant throughout south-

west Texas on prairies. Not very important for honey, but an excellent pollen plant in early summer when bee forage is scarce.

Huisache. (*Acacia farnesiana* Willd.) Abundant from San Antonio southward throughout the Gulf coast country. A good honey yielder and excellent for stimulating early brood. Yields pollen. February, March and April.

Plum. (*Prunus domestica* L.) Honey yield good. Valuable for early brood. February to March.

Wild plum. (*Prunus cerasus* L.) Abundant in waste places throughout the humid sections. February to March. Valuable for early brood.

Bridal wreath. (*Spiræa virginiana* Britt.) Ornamental shrub; helps early brood.

Dewberry. (*Rubus trivialis* Mx.) Wild low bush blackberry. Yields honey and pollen in April. Widely distributed.

Hawthorne. White thorn. (*Crataegus arborescens* Ell.) Moist ground southern and western Texas west to Colorado River. Good honey and pollen plant. April.

Rose. Blooms throughout season. Good for pollen.

Apple. (*Malus malus* (L.) Britt.) Scarce. Yields honey March 15 to April 10. Helps early brood.

Peach. (*Amygdalis persica* L.) Widely cultivated. Valuable in building up colonies in spring. February to April.

Evening primrose. (*Jussiaea diffusa* Forskl.) Wet places eastern and central Texas. June to middle of August, and where abundant it is very important during drouth.

Gaura filiformis Small. Sandy soils of central Texas, yielding surplus in seasons of sufficient rain.

Musk melon. (*Cucumis melo* L.) Widely cultivated. Good honey and pollen plant. Early summer to fall.

Prickly pear. (*Opuntia engelmannii* Salm. and Dyck.) Common, southwestern Texas. Heavy honey yielder, sometimes giving surplus. Bee-keepers report that when honey is first stored it is of a rank flavor. May to June.

Dogwood. (*Cornus asperifolia* Mx.) Sparingly in low lands, eastern and central Texas. Favorite with bees and honey yield good, but not very heavy. March to April.

Elder. (*Sambucus canadensis* Linn.) Sparingly in moist places throughout Texas; a good honey plant. April and May.

Coral berry. (*Symphoricarpas symphoricarpos* L.) Along wooded streams near College Station. Blooms July to September and is a good honey plant.

Cucumber. (*Cucumis sativus* L.) Cultivated. Good honey plant, but scarce and of short duration.

Pumpkin. (*Cucumis pepo* L.) A better pollen than honey plant. May to June.

Watermelon. (*Citrullus citrullus* (L.) Karst.) A good honey and pollen plant; at its best on dewy mornings. Blooming period extends over the greater portion of the summer until frost.

Wild gourd. (*Cucurbita foetidissima* H. B. K.) Scatteringly, southern and western Texas. Honey flow light; better for pollen. April to July.

Black haw. (*Viburnum rufotomentosum* Small.) Woodlands of central and western Texas. Good honey yielder early in season and valuable for early brood.

Bush honeysuckle. (*Lonicera fragrantissima* Lindel.) A small bush cultivated on the campus at College Station. Earliest honey yielder of the locality, furnishing honey as early as January. Valuable for early brood in mild winters.

White-flowered honeysuckle. (*Lonicera albiflora.*) Recorded from Hunter, Texas, blooming from May to July. A good honey plant but scarce.

Houstonia angustifolia Mx. Dry soils throughout Texas. May to July. Bees work well on it, but plants are scarce.

Button weed. (*Diodia teres* Walt.) Low sandy soils of Texas. Not a heavy yielder, but important in July and August where horsemint and cotton is not heavy.

Button bush. (*Cephalanthus occidentalis* L.) In moist soils throughout Texas. Bees work on it during July.

Goldenrod. (*Solidago* spp.) Throughout Texas. Abundant in late fall, but unimportant where broom and bitter weed is abundant.

Roman wormwood. (*Ambrosia artemisiifolia* L.) Common on dry uplands, yielding pollen.

Tall ragweed. (*Ambrosia aptera* D. C.) Low soils throughout southern and western Texas. July and August, yielding adhesive pollen.

Great ragweed. (*Ambrosia trifida* L.) Moist land, central and eastern Texas. July and August. Good for pollen.

Cockle burr. (*Xanthium canadense* Mill.) Common in river bottoms, yielding pollen in September and October.

Common sunflower. (*Helianthus annuus* L.) Common in waste fields. Good honey yield, but strong flavored. Yields propolis.

Sneeze weed. Bitter weed. (*Helenium tenuifolium* Nutt.) Common in open waste places of eastern and central Texas. Yields honey

and pollen. The honey is bitter as quinine, but owing to its long-continued blooming period from June to frost, it is an important plant for winter stores.

Marigold. (*Gaillardia pulchella* Fang.) Common throughout Texas. Yields surplus. Honey dark amber. May to June.

Dandelion. (*Taraxicum officinale* Weber.) Common. Yields some honey of strong flavor.

Blue thistle. (*Cnicus altissimus* Willd.) West to Guadalupe River. July and August. Bees work on it heavily at times.

Parthenium. (*Parthenium hysterophorus* L.) In waste places throughout Texas. April till frost, yielding honey and white pollen.

Broom weed. (*Gutierrezia texana* T. & G.) Open prairies throughout Texas. Honey dark and of strong flavor. Important for winter stores. September and October.

Texas persimmon. (*Diospyros texana* Schule.) Woodlands and ravines, southern and central Texas. Good honey yielder. April and June.

Common persimmon. (*Diospyros virginiana* L.) West to Colorado River. A good honey plant but scarce. Blooms a little earlier than *D. texana*.

Gum elastic. (*Bumelia languinosa* Pers.) Woodlands, eastern and southern Texas. Good honey plant, but blooming period short. June 25 to 30.

Privet. (*Ligustrum vulgare* L.) A good honey plant, but flowers scarce owing to annual trimming.

Milkweed. (*Asclepias* sp.) Good honey plant at Beeville, but pollen attaches to bee's feet and cripples them.

Dense-flowered Phacelia. (*Phacelia conjesta* Hook.) Common, blooming April to June. Some honey. *P. glabra* yields some honey.

Borage. (*Borage officinalis* L.) Cultivated at College Station. A good honey plant in June. Stalks die during drouth, but revive and bloom again later in season.

Morning glory. (*Ipomoea caroliniana* Prush.) Throughout eastern, central and southern Texas, blooming during summer, yielding a light flow of honey and pollen.

Night shade. (*Solanum rostratum* Duval.) Yields some honey and pollen from May to October.

Trumpet creeper. (*Campsis radicans* L.) Humid sections of Texas. Honey yield light; pollen from external nectar glands and stems of flowers.

Fog fruit. (*Lippia nodiflora* L.) Honey yield light during July.

White brush. (*Lippia ligustrina* Britt.) Abundant in southwest

Texas. Blooms May to September, yielding a heavy honey flow of fine quality.

French Mulberry. (*Callicarpa americana* L.) Abundant in rich soils of central and southern Texas, yielding honey.

Salvia. (*Salvia roemeriana* Sch.) Yields honey during summer in western Texas, but bees are handicapped by deep corollas.

Salvia azurea Lam. Throughout Texas, but corollas very deep. Visited by bumblebees. April to October.

Lantana. (*Lantana camara* L.) Yields some honey. April to October.

Virginia crownbeard. (*Verbena virginica* L.) In rich wooded lowlands of central, southern and western Texas. October. A heavy yielder of fine honey.

Blue vervain. (*Verbena officinalis.*) Throughout Texas. April to August, yielding a light honey flow through the season.

Catnip. (*Nepeta cataria* L.) Cultivated in the experimental plats at the apiary at College Station in 1904. The plants did not prosper; those that bloomed were visited by bees.

Wild bergamot. (*Monarda fistulosa* L.) Sparingly on dry soils of Texas. May to July. An excellent honey plant.

Horsemint. (*Monarda clinopodioides* Gray.) Waste lands of eastern and southern Texas. May 20 to June 20; an excellent honey plant, being one of the main yielders, the honey comparing favorably with that of basswood.

Horsemint. (*Monarda punctata* L.) Waste prairies, eastern and southern Texas. Abundant along railroad tracks; one of the main honey plants. May to July.

Common hoarhound. (*Marrubium vulgare* L.) Throughout the State; a good yielder of a dark amber-colored honey from February to mid-summer.

Drummond's skullcap. (*Scutellaria drummondii* Benth.) Throughout Texas; a good honey yielder in April and May.

Common pigweed. (*Amaranthus retroflexus* L.) Throughout Texas. Yields some honey and pollen July to September.

Spiny amaranth. (*Amaranthus spinosus* L.) Bees visit it, obtaining a small amount of pollen. August.

Buckwheat. (*Fagopyrum fagopyrum* (L.) Karst.) Cultivated. Our records are from College Station. Yields fair quantities of honey on dewy mornings, but is handicapped in dry atmosphere. We found it a very good plant to bridge dearths.

Mistletoe. (*Phoradendron flavescens* (Pursh) Nutt.) A parasitic

plant, growing on oak, elm, hackberry, and mesquite. Blooms from December to February. A good honey and pollen plant.

Spurge. (*Euphorbia marginata* Pursh.) Low lands of western Texas, yielding honey during summer and fall.

Sonora croton. (*Croton sonoræ* Torr.) Observed in Llano and Comal counties. Although honey flow is light, it comes during the July and August dearths.

Goat weed. (*Croton capitatus* Mx.) Central and southern Texas. Not important in bee sections, but valuable where the honey flora is scarce. At College Station it is a good pollen plant during August.

Texas croton. (*Croton texensis* Muell.) Western Texas. A light honey yielder during summer from June to August.

One seeded croton. (*Croton monanthogynus* Michx.) Central and southern Texas. May to June. Honey yield fair.

Castor-oil plant. (*Ricinus communis* L.) Cultivated throughout State; sparingly escaped. Honey and pollen yield good. Nectar glands at base of leaf. March and April.

American elm. (*Ulmus americana* L.) Low woodlands of central Texas. Good honey and pollen plant, sometimes yielding surplus. The honey is amber and characteristically aromatic. August to September. Also known as "wahoo."

Granjena. (*Celtis pallida* Torr.) Bee-keepers report it an important plant. We have no other records.

Hackberry. (*Celtis mississippiensis* Bosc.) Common in central Texas. Fair honey yielder and good for pollen early in the season.

Hackberry. (*Celtis occidentalis* L.) Cultivated for shade throughout Texas. Occurs in ravine at College Station. Fair honey plant and good pollen yielder. Valuable for early brood.

Osage orange. (*Toxylon pomiferum* Ruf.) Planted for hedges in humid sections. April. Yields honey but plants are scarce.

Hickory. (*Hicoria alba* L.) Common in sandy lowlands, yielding some honey and pollen in March.

Pecan. (*Hicoria pecan* Britt.) Cultivated and wild. Good for pollen. March.

Post oak. (*Quercus minor* Sarg.) Sandy soils, eastern and central Texas. Its quantities of pollen during March and April make it a valuable plant for early brood.

Black jack. Barren oak. (*Quercus marylandica* Muench.) In post oak woods. Yields pollen in early spring.

Live oak. (*Quercus virginiana* Mill.) Southern and western Texas. A good honey plant for early brood in March. Honey dark colored.

Red oak. (*Quercus rubra* L.) Westward to San Antonio. Yields pollen in March. Trees scarce.

Spanish oak. Pin oak. (*Quercus palustris* Duroi.) West to San Antonio. A good honey and pollen plant. Valuable for early brood.

Water oak. (*Quercus aquatica* Walt.) Moist soils, eastern and central Texas west as far as Austin. Pollen in early spring, but the plant occurs sparingly.

Black willow. (*Salix nigra* March.) Wet places. A good honey and pollen plant. Valuable for early brood. February to April.

Cotton wood. (*Populus deltoides* Marsh.) Low lands everywhere. Fair honey plant, but a better pollen yielder for early brood. March.

Cat briar. (*Smilax bona-nox* L.) Everywhere. Grows in thickets, yielding honey, but bloom of short duration. April 10 to 25.

Virginia spiderwort. (*Tradescantia gigantea* Rose.) Scatteringly on prairies. Yields some pollen for early brood.

Sorghum. (*Sorghum vulgare* Pers.) Cultivated for forage and hay. Yields honey, but it is particularly valuable for the abundance of pollen during June.

Indian corn. (*Zea mais* L.) Valuable pollen plant from May to June.

Silver berry. (*Elaeagnus argentia* Pursh.) Cultivated for ornamental purposes at College Station. The honey from the nectar glands runs down the long corollas where the bees can get it. Blooms in spring and fall.

Sweet olive. (*Elaeagnus angustifolia* L.) One bush at College Station. Honey yield good. April.

Firmiana platinifolia (L.) R. Br. Ornamental at College Station. Heavy honey yielder from May 10 to June 15.

Crepe myrtle (*Lagerstroemia indica* L.) Cultivated. Blooms June to October, bees working heavily at intervals.

While, upon examining the list of honey plants, it will be noticed that the heavy yielders are few, one or more species occur in all parts of the State. Bee-keeping can be carried on only where the honey flow is continuous when the bees are active. The many minor plants here recorded are of great value in keeping colonies in good condition during the intervals between the surplus yielders. In sections where dearths occur they may be bridged by cultivated species, provided the conditions of the locality are known so that the work can be planned with approximate accuracy. A great field is open in Texas for the distribution of honey plants for the purpose of producing a continual honey flow in sections where the bee-keeping industry is at present handicapped by dearths. By close observation bee-keepers should

soon learn what plants could be utilized for this purpose, employing either cultivated species or wild plants obtained from seed scattered in waste places.

FEDERAL PROTECTION TO AMERICAN AGRICULTURE AND HORTICULTURE FROM INVASION BY FOREIGN INSECT PESTS

By JACOB KOTINSKY, *Honolulu, Hawaii.*

(Withdrawn for publication elsewhere.)

It was impossible to publish the following paper in regular sequence, owing to a failure to submit the manuscript in due time. The discussion relating thereto follows. ED.

LIFE HISTORY OF THE STRIPED CUCUMBER BEETLE WITH A BRIEF ACCOUNT OF SOME EXPERIMENTS FOR ITS CONTROL

By T. J. HEADLEE, *Manhattan, Kan.*

In this paper it is purposed to give briefly the results of a study of the striped cucumber beetle, undertaken at the New Hampshire station for the purpose of clearing up certain doubtful points in its life history, its action under local conditions, and the practicability of the common remedial measures. Credit is due Prof. Sanderson for constant aid and encouragement.

Life History

Egg. In 1907 the first eggs discovered were laid by a caged beetle on July 2d, but it was not until July 16th that they were found in the field. Eggs were last taken in the cages the 7th of August, and oviposition in the field appeared to have ceased some time before. The egg-laying period, therefore, occupies about one month in New Hampshire.

The eggs are deposited singly or, with equal frequency, in groups, in the soil, usually just beneath the surface, but sometimes on the surface or, again, a considerable distance down. The variation seems to be largely dependent upon the compactness and moisture of the ground. When it was dry and cracked, the beetle was likely to deposit her eggs on the moist soil in some crevice, but if damp and com-

pact, she would deposit them in shallow crevices; or even right on the surface. The female certainly shows a preference for a crack or crevice as a place to deposit her eggs. She oviposits in the soil anywhere within a radius of five or six inches of the stem of the young plant. Although the eggs are frequently laid between the plant stem and the surrounding earth, we have found no evidence to show that this is a favorite place. In instances where oviposition was observed, and this happened to be on damp soil, she simply brought the tip of her abdomen down nearly or quite to the surface of the ground, and pushed the eggs out, or, finding a furrow, she crawled into it and deposited eggs on the sides and bottom.

Experiment has shown that while the eggs are generally deposited on moist soil, they can withstand some desiccation if again returned to moist conditions, but that they never hatch if kept continuously in a dry situation.

A dissection of 18 gravid females collected at different times from late June to September showed an average of only 33 well-developed eggs per individual, with the upper extreme as 59. Yet in the breeding-cages, five females produced an average of 88 eggs each, with 54 and 117 as extremes. The cage records indicate that, once the beetle begins to oviposit, she continues at frequent intervals until her supply of eggs is exhausted.

Careful records of 32 eggs show that an average of 8.75 days is required under an average mean temperature[1] of 74° F. with an accumulation of 653.8° F. (read) or 651.03° F. (measured) to bring them from deposition to hatching.

Inasmuch as recent studies point to the fact that each insect has a different critical temperature, no effort has been made to compute the effective temperature, but the amount given represents all the degrees above 0° F.

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[1]The average mean temperature has been computed by (1) averaging the mean temperature of the days through which each egg passed before hatching, and then (2) averaging the average mean temperature of all the eggs. The mean temperatures of the days through which each egg passed were summed for each egg, and the average sum of the temperatures for all the eggs was taken as the sum temperature of the egg stage. Finding that the daily mean derived by measuring the irregular polygon made by the thermograph pen on the revolving record-sheet showed less variation, and hence was likely to be freer from the variation to which any such instrument is likely to be subject, I have given it as the *measured* sum, and also to conform to common practice, the sum derived in the usual way has been given as the *read* sum. In case the average means were practically the same, only one has been given, but when both are given, they are distinguished by the same method as that used in distinguishing the sum temperatures.

Larva. Even when first hatched, the larva can crawl rapidly about and, fastening its single proleg, can raise one-half of its body free of support and wave it about. Under moist conditions the just-hatched larva can remain active for as much as two days without food, but if subjected to drying, it will quickly perish. Careful experiments have shown that the just-hatched larva can crawl at least four inches through moist soil under ordinary weather conditions. There is, however, no evidence to show that it crawls in any especially determined direction, except, possibly, downward. It will as readily crawl away from food as toward it, but enters the soil at the first crevice it finds. As the larva grows, the yellow color so characteristic in early stages becomes less and less apparent until, in its later stages, it is white without a trace of yellow. During its entire life, the larva lives in the soil on or in the roots of its food plant, or in the stem. It is perfectly capable of passing from root to root, or even from plant to plant. So long as the larva has moist soil it can live and work for its food, but with the advent of drought it dies. Certainly these experiments and observations abundantly confirm Sirrine's statement that the larva requires moist earth to live in. When it becomes full-grown, it crawls out of and away from the plant from one-fourth of an inch to several inches, and by turning movements of its body, forms an oval earthen cell. The cell is frail, but very smooth and cozy, with no evidence of silk of any sort being used in its construction. This cell may be broken and, unless the larva has begun to shorten and stiffen for pupation, it will crawl away and construct a new one.

By the records of 24 individuals the length of time required to pass from hatching to larval cell was shown to vary from 26 to 38 days, with an average of 28.1. This stage was passed under an average daily mean temperature of 73° F. with sum temperatures of 2068.9° F. (read) or 2063.8° F. (measured).

Pupa. The location of the pupal cell appears to vary with moisture. It is always, so far as our observation goes, constructed in moist soil, although later it may become very wet or very dry. The actual location of the cells varied from one-half to two and one-half inches below the surface.

Records for 10 pupæ show an average of 13.9 days as the length of pupal stage. Records of 14 individuals show that an average of 24 days is required for the insects to pass from larval cell to adult, under an average mean temperature of 66° F. (read) or 65° F. (measured), with a sum temperature of 1590.78° F. (read) and 1576.78° F. (measured).

Seasonal History. The beetles were first observed in 1907, June

1st, on a small elm bush growing in a slough in the midst of heavy conifer timber. They were found in the same situation again two days later. On June 18th they were found on the blossoms and leaves of syringa near the experiment station in such numbers that we counted at least a half-dozen every time we visited the bush. Throughout June 19th and 20th they continued to feed in the same place and in about the same numbers. On June 21st the beetles were discovered in great numbers on volunteer squash near a small woodland, and by June 24th they had appeared in injurious numbers in a squash patch that lay a little farther from the same woodland. At this time they were found copulating freely. On June 25th they appeared in injurious numbers on the trap squash of our cucumber experimental plats. These plats were twice as far from the woodland as the squash fields first infested. By June 26th the beetles had begun to eat the cucumbers, but evidently preferred the squash plants, picking them out even from the midst of cucumber plants. On June 29th they appeared for the first time in the experimental plats of squash. This was fully one-eighth of a mile from any woodland and the late infestation points significantly to the probable winter quarters of the beetles. They continued in the plats from this time forward until August, in the latter part of which the remainder of the old brood practically disappeared. The new brood, particularly the males, began to appear in late August and the majority were out by the middle of September. Practically all had gone into winter quarters by early October. Dissection of material collected at intervals from June until the middle of October showed clearly that the species is single-brooded in New Hampshire.

It has been found that the disturbance necessary to the determination of length of pupal period hastened the development of the insects. It was, of course, necessary to break the earthen cells and, once pupation had occurred, no more cells were constructed. The pupæ exposed were carefully embedded in moist earth and allowed to produce adults. Twenty-two individuals that came through to adults and were thus disturbed at pupation, occupied an average of 47.81 days under an average mean temperature of 70° F. and with an accumulation of 3363.04° F. (read) or 3351.5° F. (measured), while 14 specimens that passed without disturbance from hatching to adult required an average of 55.14 days under an average mean temperature of 69° F., with an accumulation of 3814.96° F. (read) or 3802.35° F. (measured). The specimens that were disturbed by breaking the pupal cell required an average of 56.5 days to pass from deposition of egg to adult beetle, under an average temperature of 70° F. with

an accumulation of 4016.8° F. (read) or 4002.5° F. (measured), while those that were thus undisturbed required an average of 63.8 days under an average mean temperature[2] of 70° F., with an accumulation of 4468.78° F. (read) or 4453.3° F. (measured).

Injury

The insect injures the plants both as an adult and as a larva, but in New Hampshire the adult is much the more serious, for it attacks the plants while they are young and when they are less able to withstand injury. Frequently it will attack the stalk just below the surface of the ground and eat almost, if not quite, through it. Many an injured plant will not be eaten enough to kill it, but the wound will harden and the plant grow, even until it has begun to run, when the first hard wind snaps it off at the point of injury. If the insects are abundant and prompt measures are not taken, the whole crop will be utterly destroyed in a few days. Even when plants have reached a height of three or four inches and have grown strong and stocky, the beetles will sometimes concentrate, especially on replants, and destroy them.

In New Hampshire the larvæ are rarely sufficiently abundant to do serious damage, although plants may be found every year which have been attacked and killed by them. Larvæ have been found among squash roots in the field, but there was little evidence that they had been feeding on the finer roots and only a few instances where they were found feeding on the larger ones. In potted squash where the larvæ were relatively more abundant, they were found feeding within the roots and the stems, even going as high as three or four inches above the ground. Certainly where the larvæ were sufficiently abundant, they would do serious damage.

From the time the plants begin to flower, the beetles desert the foliage and feed on the pollen until driven into winter quarters in the fall.

Natural Enemies

Certainly at least one, if not two, dipterous parasites prey on adult beetles, and doubtless many such predaceous enemies as ground

[2]The average mean temperature for the whole period was determined in this case by dividing the accumulated temperature by the total number of days required for the transformation, and the accumulated temperatures were determined by adding the average accumulated temperature for egg-state to average accumulated temperature for period extending from hatching to adult. Circumstances rendered the data such that the average mean and accumulated temperatures from egg-deposition to adult could not be computed directly.

beetles and ants feed on the larvæ. Dissections, beginning with beetles collected in June and extending to the time the beetles left the plants, show first a great increase and then a decrease of parasitism, as the following per cents will indicate. Beetles collected during the first two-thirds of June showed 3% containing parasites; those on June 28th, 7%; those on July 30th, 7½%; those on August 5th, 18%; those on August 8th, 42½%; those on August 13th, 50%; those on August 14th, 50%; those on August 22d, 24%; those on August 31st, 12%; those on September 7th, 0%; those on September 12th, 0%; those on September 18th, 0%.

Some idea of the mortality that may well occur in nature may be gathered from the fact that in soil regularly watered and kept constantly producing young plants, out of 329 larvæ introduced into the soil at hatching, only 34 reached maturity.

Methods of Combating

In the study of artificial methods we experimented with several substances as preventatives, as the solution of this problem appears to lie in prevention rather than in cure. One-half of an acre of cucumber plants and two and one-half acres of squash were used in the experiment. These were divided into plats and treated with Bordeaux (3 pounds Copper Sulphate, 4 pounds lime, to 50 gallons of water), Bordeaux plus Paris green, air-slaked lime plus sulphur, sulphur, "Bug Death," Hammond's "Slug-Shot," tobacco dust, road dust, arsenate of lead (3 pounds to 50 gallons), and arsenate of lead (6 pounds to 50 gallons). The Bordeaux plats were further protected by plantings of squash as trap crops, according to Sirrine's suggestion.

The beetles were serious enough to destroy only about one-fourth of the plants in the check plats, but the effect of their work was well shown in the setback these plats experienced. Bordeaux mixture alone or with Paris green, sulphur, and "Slug-Shot" appeared to stunt the plants. Road dust afforded but little protection. "Bug Death" and tobacco dust when used carefully enough seemed to be fairly efficient, but the air-slaked lime and sulphur mixture seemed just as successful and was certainly much cheaper. Arsenate of lead, however, gave the most efficient protection and injured the plants least of any mixture used. Three pounds seemed almost as successful as six pounds. Our experiments would lead us to advise the following treatment where fungus enemies are a serious problem: Plant trap squash for either cucumber or squash between the hills of every other row, or if the piece be small, about the edge a week or ten days before

the regular crop is set out; plant other trap seed when the regular crop is put in; plant still other trap seed a week or ten days later; keep the regular crop sprayed with arsenate of lead (3 pounds to 50 gallons) until the plants begin to run, then keep sprayed with Bordeaux mixture (3 pounds Copper Sulphate, 4 pounds of lime, 50 gallons of water).

From the very nature of these materials, it is evident that in a bad beetle year, they would be insufficient to protect the plants. In such cases, the only efficient method of protection is by means of covers. Many forms have been invented, all either costly to purchase or to apply, and some both. But the market gardener, who can secure high prices for his prime cucumbers, can afford to use them, so I will take a few minutes of your time in suggesting what has seemed to us a practical sort of cover. Secure yard-wide screen wire of slightly smaller mesh than the ordinary window screening, and cut off one yard. The piece will then be one yard each way. Describe a circle on this piece, having a diameter of 36 inches, and cut off the corners. Then divide this circular piece of wire into two equal parts. Join the cut edges by drawing them together and folding them over, hammering them down firmly. Thus a cone-shaped wire cover costing a few cents and capable of withstanding several years' usage is ready for use. Two covers can be made from each square yard of wire.

Mr. J. B. Smith suggested that the wire used for screens to protect the plants must have a very small mesh.

Mr. R. L. Webster asked concerning the parasites bred from *Diabrotica*, and in reply Mr. Headlee stated that they were Tachinids.

Mr. Burgess inquired concerning the length of time that the adults deposited eggs. He had been able to secure eggs for two successive seasons from a female of *Calosoma frigidum* that had been kept in captivity. To this Mr. Headlee replied that as far as he had observed, the females of *Diabrotica vittata* deposited all their eggs in one season.

A. F. BURGESS, *Secretary*

UNIFORM COMMON NAMES FOR INSECTS

By A. F. BURGESS, *Washington, D. C.*

At the sixteenth annual meeting of the Association of Economic Entomologists held at St. Louis, Mo., in December, 1907, a Committee on Nomenclature was elected to secure the adoption of uniform names for our more common insects. In the past much confusion has re-

sulted from the use of the same name for a number of entirely different insects, and the work was undertaken in the hope of gradually overcoming the difficulty.

Since that meeting the committee has prepared lists which have been submitted to the leading entomologists of the country for their consideration and approval. All names which were unanimously approved were presented at the next annual meeting of the Association, and those that received unanimous support by that body were ordered printed in the annual report, with the recommendation that they be used exclusively in all publications.

In order to accomplish the object for which this work was undertaken, it is necessary for all entomologists, publishers, editors and writers to use the approved names, and all are urged to do so.

The committee, at the present time, is Prof. Herbert Osborn, Chairman, Columbus, Ohio; Prof. E. G. Titus, Logan, Utah, and Prof. A. L. Quaintance, Washington, D. C. Communications concerning the adoption of names not already listed or suggestions should be sent to the Chairman of this committee.

The following, prepared on the recommendation of the committee, is a complete list of the names which have been accepted during the past four years:

LIST OF NAMES RECOMMENDED FOR EXCLUSIVE USE

American cockroach	*Periplaneta americana* L.
American dagger moth	*Apatela americana* Harr.
Angoumois grain-moth	*Sitotroga cerealella* Ol.
Apple-aphis	*Aphis pomi* L.
Apple curculio	*Anthonomus quadrigibbus* Say.
Apple-leaf skeletonizer	*Canarsia hammondi* Riley.
Apple maggot	*Rhagoletis pomonella* Walsh.
Apple twig-borer	*Schistoceros hamatus* Fab.[a]
Army-worm	*Heliophila unipuncta* Haw.
Ash-gray blister-beetle	*Macrobasis unicolor* Kby.
Asiatic ladybird	*Chilocorus similis* Rossi.
Asparagus beetle	*Crioceris asparagi* L.
Bag-worm	*Thyridopteryx ephemeraeformis* Haw.
Bean-weevil	*Bruchus obtectus* Say.
Bedbug	*Cimex lectularius* L.
Black blister-beetle	*Epicauta pennsylvanica* DeG.
Black cutworm	*Agrotis ypsilon* Rott.
Black scale	*Saissetia oleae* Bern.
Blood-sucking cone-nose	*Conorhinus sanguisuga* Lec.
Boll-weevil	*Anthonomus grandis* Boh.

a. Synonym, *Amphicerus bicaudatus* Say. (See Lesne, P. Revision des Bostrychides. Ann. Soc. Ent. France, 67: 513, 514, 1898.)

Boll-worm ..... *Heliothis obsoleta* Fab.
Book-louse ..... *Troctes divinatoria* Mull.
Bronzed cutworm ..... *Nephelodes minians* Guen.
Brown-tail moth ..... *Euproctis chrysorrhœa* L.
Buck moth ..... *Hemileuca maia* Dru.
Bud-moth ..... *Tmetocera ocellana* Schiff.
Buffalo tree-hopper ..... *Ceresa bubalus* Fab.
Cabbage aphis ..... *Aphis brassicae* L.
Cabbage looper ..... *Autographa brassicae* Riley.
Cabbage-maggot ..... *Pegomya brassicae* Bouche.
Cadelle ..... *Tenebrioides mauritanicus* L.
Carpet-beetle ..... *Anthrenus scrophulariae* L.
Carpet-moth ..... *Trichophaga tapetzella* L.
Catalpa sphinx ..... *Ceratomia catalpae* Boisd.
Cattle-tick ..... *Boophilus annulatus* Say.
Cecropia-moth ..... *Samia cecropia* L.
Chaff scale ..... *Parlatoria pergandei* Comst.
Cheese skipper ..... *Piophila casei* L.
Cherry scale ..... *Aspidiotus forbesi* Johns.
Chestnut weevil ..... *Balaninus rectus* Say.
Chinch-bug ..... *Blissus leucopterus* Say.
Cigarette beetle ..... *Lasioderma sericorne* Fab.
Clover cutworm ..... *Mamestra trifolii* Rott.
Clover-hay worm ..... *Hypsopygia costalis* Fab.
Clover mite ..... *Bryobia pratensis* Garm.
Clover-root borer ..... *Hylastinus obscurus* Marsham.
Clover-stem borer ..... *Languria mozardi* Latr.
Codling-moth ..... *Carpocapsa pomonella* L.
Colorado potato-beetle ..... *Leptinotarsa decemlineata* Say.
Corn root aphis ..... *Aphis maidi-radicis* Forbes.
Cotton-stainer ..... *Dysdercus saturellus* H. Schf.
Cottony cushion-scale ..... *Icerya purchasi* Mask.
Cottony maple-scale ..... *Pulvinaria innumerabilis* Rathv.
Currant borer ..... *Aegeria tipuliformis* Clerck.
Dingy cutworm ..... *Feltia subgothica* Haw.
Elm-borer ..... *Saperda tridentata* Ol.
Fall armyworm ..... *Laphygma frugiperda* S. & A.
Fall canker-worm ..... *Alsophila pometaria* Harr.
Fall web-worm ..... *Hyphantria cunea* Dru.
Forest tent-caterpillar ..... *Malacosoma disstria* Hbn.
Garden webworm ..... *Loxostege similalis* Guen.
Glassy cutworm ..... *Hadena devastatrix* Brace.
Granary-weevil ..... *Calandra granaria* L.
Grape leaf-folder ..... *Desmia funeralis* Hbn.
Grape flea-beetle ..... *Haltica chalybea* Ill.
Grape-phylloxera ..... *Phylloxera vastatrix* Planch.
Gray blister-beetle ..... *Epicauta cinerea* Forst.
Gypsy-moth ..... *Porthetria dispar* L.
Harlequin cabbage-bug ..... *Murgantia histrionica* Hahn.
Hessian-fly ..... *Mayetiola destructor* Say.
Hickory borer ..... *Cyllene picta* Dru.

Honey-bee ..... *Apis mellifera* L.
Hop-aphis ..... *Phorodon humuli* Schrank.
Horn-fly ..... *Haematobia serrata* R.-D.
Horse bot-fly ..... *Gastrophilus equi* L.
House cricket ..... *Gryllus domesticus* L.
House-fly ..... *Musca domestica* L.
Imbricated snout beetle ..... *Epicaerus imbricatus* Say.
Indian-meal moth ..... *Plodia interpunctella* Hbn.
Lappet moth ..... *Epicnaptera americana* Harr.
Larder-beetle ..... *Dermestes lardarius* L.
Leaf crumpler ..... *Mineola indiginella* Zell.
Leopard-moth ..... *Zeuzera pyrina* L.
Margined blister-beetle ..... *Epicauta marginata* Fab.
Mediterranean flour moth ..... *Ephestia kuehniella* Zell.
Melon caterpillar ..... *Diaphania hyalinata* L.
New York weevil ..... *Ithycerus noveboracensis* Forst.
Northern mole cricket ..... *Gryllotalpa borealis* Burm.
Onion maggot ..... *Phorbia cepetorum* Meade.[b]
Onion thrips ..... *Thrips tabaci* Lind.
Orange scale ..... *Aonidiella aurantii* Mask.
Oyster-shell scale ..... *Lepidosaphes ulmi* L.
Pale-striped flea-beetle ..... *Systena blanda* Melsh.
Palmer-worm ..... *Ypsolophus ligulellus* Hbn.
Peach-borer ..... *Sanninoidea exitiosa* Say.
Peach-scale ..... *Eulecanium persicae* Fab.
Pear psylla ..... *Psylla pyri* L.
Pear-slug ..... *Eriocampoides limacina* Retz.
Pea-weevil ..... *Bruchus pisorum* L.
Pickle worm ..... *Diaphania nitidalis* Cram.
Pigeon-tremex ..... *Tremex columba* L.
Pistol case-bearer ..... *Coleophora malivorella* Riley.
Plum-curculio ..... *Conotrachelus nenuphar* Hbst.
Plum-gouger ..... *Anthonomus scutellaris* Lec.
Potato stalk-borer ..... *Trichobaris trinotata* Say.
Putnam's scale ..... *Aspidiotus ancylus* Putn.
Raspberry sawfly ..... *Monophadnoides rubi* Harr.
Red-legged locust ..... *Melanoplus femur-rubrum* DeG.
Rice-weevil ..... *Calandra oryza* L.
Rose-chafer ..... *Macrodactylus subspinosus* Fab.
Rose sawfly ..... *Endelomyia rosae* Harr.[c]
Rose scale ..... *Aulacaspis rosae* Bouché.
Saddle-back caterpillar ..... *Sibine stimulea* Clem.
Salt-marsh caterpillar ..... *Estigmene acraea* Dru.
San José scale ..... *Aspidiotus perniciosus* Comst.
Screw-worm ..... *Chrysomyia macellaria* Fab.

b. This species is placed by Coquillett in the genus Pegomya Desvoidy. (See Chittenden, Cir. 63, 2d. ed. Bur. Ent., U. S. Dept. Agr., p. 6, footnote 2, 1906.)

c. For reference of this species to the genus Endelomyia see Ashmead. (Can. Ent., 30: 256. October, 1898.)

Scurfy scale.....*Chionaspis furfura* Fitch.
Sheep tick.....*Melophagus ovinus* L.
Silkworm .....*Bombyx mori* L.
Spring canker-worm.....*Paleacrita vernata* Peck.
Squash borer.....*Melittia satyriniformis* Hbn.
Squash-bug .....*Anasa tristis* DeG.
Stable fly.....*Stomoxys calcitrans* L.
Stalk borer.....*Papaipema nitela* Guen.
Strawberry crown-borer.....*Tyloderma fragariae* Riley.
Strawberry leaf-roller.....*Ancylis comptana* Fröhl.
Strawberry weevil.....*Anthonomus signatus* Say.
Striped blister-beetle.....*Epicauta vittata* Fab.
Tarnished plant-bug.....*Lygus pratensis* L.
Tomato-worm .....*Phlegethontius sexta* Joh.
Turkey gnat.....*Simulium meridionale* Riley.
Variegated cutworm.....*Peridroma saucia* Hbn.
Vagabond crambus.....*Crambus vulgivagellus* Clem.
Walking-stick .....*Diapheromera femorata* Say.
Walnut case-bearer.....*Mineola juglandis* LeB.
Walnut-sphinx .....*Cressonia juglandis* S. & A.
Wheat-head army-worm.....*Heliophila albilinea* Hbn.
Wheat midge.....*Contarinia tritici* Kby.
White-lined sphinx.....*Deilephila lineata* Fab.
Yellow mealworm.....*Tenebrio molitor* L.
Yucca-moth .....*Pronuba yuccasella* Riley.
Zebra-caterpillar .....*Mamestra picta* Harr.

TICK-BORNE DISEASES AND THEIR ORIGIN

By NATHAN BANKS, *Washington, D. C.*

Texas or splenetic fever was first described as a disease of cattle in this country by Dr. J. Pease about 1795 from an outbreak at Lancaster. He concluded that it was due to an importation of cattle from North Carolina. Gradually it was discovered that when southern cattle were brought north in summer, northern cattle along the route would sicken and die, while northern cattle taken south also contracted the disease, although the southern cattle generally remained in good health.

It had long been known to cattle-raisers in the southern states that cattle dying from Texas or Spanish fever were infested with ticks, and it was therefore quite natural for them to attribute the disease to the tick. Veterinarians, however, did not believe it, and Gamgee, in his extensive report on the diseases of cattle (1869), argued against the supposed connection. In 1890 Dr. P. Paquin considered the tick as one agent in transmission, but he had little actual evidence. In 1889 Dr. F. L. Kilborne of the Bureau of Animal Industry, thought

to test the popular theory and became convinced that the presence of the cattle-tick was necessary to the transmission of disease. Later, he, with Dr. T. Smith, proved that the tick was an intermediary host of the blood parasite causing the disease and in the same year Dr. Theobald Smith described the parasite as *Pyrosoma bigeminum*, now *Piroplasma*. The southern cattle accustomed to tick infestation from birth, become immune to the disease, but if not raised in tick-infested fields they are as susceptible to the disease as northern cattle.

Since 1890 many experiments by various observers have served to confirm Dr. Kilborne's results. Diseases similar to Texas fever occur in cattle in various parts of the world. In South Africa Lounsbury has shown that heartwater is transmitted by the "bont tick," *Amblyomma hebræum*. Later he has shown that malignant jaundice in dogs is due to the attack of a dog tick, *Haemaphysalis leachi*, and that African coast fever in cattle is carried by five species of *Rhipicephalus*. In each case there are differences in the manner of infection and the stage of the tick capable of infecting an animal, and various peculiarities in the life history of each tick.

These discoveries have served to open a wide field of suspicion and investigation, so that during the past few years ticks have been accused of transmitting many different diseases to various animals. The evidence, however, in many cases, is far from conclusive, but, doubtless, as experiments are carried on proof will become established of the culpability of other ticks in the diffusion of disease.

Louping ill in sheep is thought to be carried by an *Ixodes;* spirillosis in fowls is attributed to an *Argas;* spotted fever due to the presence of a *Dermacentor*. A disease of turtles is laid up to *Hyalomma ægyptium;* carceag, an European disease of sheep, is supposedly transmitted by *Rhipicephalus bursa*. An undetermined Ceylonese tick is credited with producing paranghi or "yaws." Infected specimens of *Ixodes ricinus* have given a piroplasmosis to European cattle; and the "moubata bug" (*Ornithodoros moubata*) is the inoculating agent of one of the most dangerous diseases dreaded by inhabitants of West Africa.

From the known results, it is evident that the power to transmit disease is not confined to any one genus or section of *Ixodidæ*, but common to all. Moreover, in different countries extremely similar diseases are carried by very different ticks. Therefore the diseases have not originated in the ticks. Most, if not all, of the species now acting as agents in the dissemination of disease to certain hosts were probably originally confined to other hosts. To their original or natural host they brought no disease. Certain low organisms living in

the blood of the host were transmitted by the ticks to other animals of the same nature without serious danger. But when a tick containing the blood parasites of one, its natural, host becomes attached to a new and different kind of host, then the blood-parasite in this alien blood may originate a disease. The occasional transference of a tick from one host to another may not be sufficient, but when a species of tick practically changes its host, then a disease may result, provided, of course, that the ticks are commonly infected with a blood parasite of their old host.

This theory of the origin of these diseases, though new to me, I find has been proposed by Dr. H. M. Woodcock in a paper on the Hæmoflagellates.* Doctor Woodcock was mostly concerned in the diseases transmitted by flies, but as he includes in his general review a reference to piroplasmosis, it is evident that he considers the tick-borne diseases as originating in the same way as the others. Doctor Woodcock's statement follows: "It follows, however, from what has been said above, that the animals for which these parasites are markedly pathogenic cannot be regarded as their true or natural hosts, which are rather to be sought among the native, tolerant animals of the locality concerned."

In accordance with this theory then, the ticks in adapting themselves to the march of civilization, the extermination of native animals and the introduction of domestic animals, have here and there transmitted to domestic animals blood-parasites that are normally found in certain wild species.

The tick is a most necessary part in the life-history of these parasites, for in some cases (perhaps all) the sexual conjugation of the parasite is consummated within the body of the tick.

It is therefore evident that all ticks are potentially dangerous. Any tick now commonly infesting some wild animal, may, as its natural host becomes more uncommon, attach itself to some domestic animal. Since most of the hosts of ticks have some blood-parasites, the ticks by changing the host may transplant the blood-parasite into the new host, producing, under suitable conditions, some disease. Numerous investigators throughout the world are studying this phase of tick-life, and many discoveries will doubtless signalize the coming years.

* Quart. Journ. Micr. Sci. (N. S.) vol. 50, p. 158, 1906.

NOTES ON TROGODERMA TARSALE MELSH.

By C. O. Houghton, *Newark, Delaware.*

In the fall of 1906 I found that a few shag-bark hickory nuts (*Hicoria ovata* Mill.) which I had in my laboratory were more or less infested with Dermestid larvæ. Wishing to determine the species responsible for the injury, I placed a nut that I had cracked and found infested in a shell vial, which I tightly corked and set upon my office desk, where I could frequently inspect it. I occasionally saw larvæ moving about in the vial and some time later observed one or more adults of *T. tarsale,* which finally died therein and were evidently eaten by the larvæ.

Having determined the species and made a note of the injury and identification of the insect responsible for it, I set the vial, which I had not opened, aside and thought no more about it for several months. On December 24, 1907, I noticed the vial again, and upon making an examination of its contents was somewhat surprised to find that it still contained living larvæ.

The shell of the nut had been broken into three or four pieces, and I had supposed that the meat had been wholly removed from these long before; at least it had appeared so from the previous examinations I had made. Nevertheless, I removed therefrom no less than fifty-eight living larvæ of various sizes, and all, apparently, in the best of condition. They were all within the pieces of shell and were unquestionably feeding upon the inside of the shell itself, for this was considerably eaten in places and not a trace of the meat of the nut could be found. In the bottom of the vial there was a considerable amount of dust and excrement, and I counted about fifty good-sized cast larval skins, more or less perfect, therein. In addition, there were numerous small pieces of skins, apparently the remains of some that had been fed upon to some extent by the larvæ. No trace of any adults was to be found, however.

The pieces of shell and the larvæ were again placed in the vial, and this was not examined again until January 18, 1908, when I found fifty-six living larvæ therein.

Early in February I noticed that one or more of the larvæ were entering the cork in the vial at a slight crack on the lower side, and a short time later (February 19) I found four good-sized larvæ snugly ensconced therein, all lying close together. They had eaten, or at least hollowed out, quite an opening at this point and I thought that possibly they were preparing to pupate therein.

An examination of the pieces of shell in the vial at that time resulted in my finding fifty-six living larvæ. Some of these were quite small, measuring but 2.5 mm. in length (exclusive of the terminal brush), and had possibly been overlooked in some of my previous examinations. The largest larva measured 6 mm. in length, exclusive of the brush. About fifteen cast skins were found at this time.

On March 30th I noticed the first adult of this brood in the vial, and upon making an examination of the pieces of shell I found fifty-four living larvæ, one of which was about to pupate. In addition, there were four living larvæ in the cork and about thirty-five cast skins mixed with the excrement and dust at the bottom of the vial.

In time I expect that all, or practically all, of these fifty-seven larvæ will reach maturity and pupate, with nothing but their present food supply to subsist upon; for it is very evident that they can maintain themselves on these rations.

T. tarsale in the larval state, has been recorded* as feeding upon a variety of substances, among which may be mentioned the following: Flaxseed, castor beans, Cayenne pepper, peanut meal, wheat, etc., but as far as I am aware it has never been reported as being able to subsist and reach maturity upon such scant rations as dry hickory nutshells.

FILLING THE CALYX CUP

A. L. MELANDER, *Pullman, Wash.*

A year ago Dr. E. D. Ball presented before the nineteenth meeting of the Association of Economic Entomologists a most valuable paper on spraying for the codling moth (Bull. 67 U. S. Bureau of Entomology). His work had led him to believe that spraying for the first brood could be so effectively done as to render later sprayings unnecessary.

The keynote of this treatment is that as the majority of larvæ, both early and late, enter the calyx cup, that part of the apple needs poison more than any other part of the tree. To place poison below the stamens requires a high pressure of 100 to 200 pounds, a coarse driving spray, and the spray must be rained down on the flowers until the tree is drenched. Arsenate of lead must be used, but it need not be stronger than one pound to fifty gallons. A mist spray will not penetrate into the lower cup, nor will a coarse spray shot directly into the tree to fall by gravity into the upturned flowers. When the lower calyx cup is full there is enough spray on the foliage and fruit

*Chittenden, Bull. No. 8, U. S. Dept. Agric., Div. of Ent., p. 19.

to poison practically all first brood larvæ that fail to reach the lower cavity. There can then be no late larvæ, and consequently apples escape late blemishing stings, as well as the chance of becoming wormy through late ineffective sprayings.

Although this method of treatment has proved not only practicable but better than any other method in the Pacific Northwest, in many districts of Colorado, Utah, Idaho, Washington, and California, there are many Eastern entomologists who firmly believe that it is inapplicable to the conditions east of the Rocky Mountains.

In the discussion of Dr. Ball's paper, as recorded in Bulletin 67 of the Bureau of Entomology, "Mr. Fletcher pointed out the desirability of not casting any doubt on the efficiency of methods now generally in vogue for controlling this insect. In Canada 70% of the apple crop is saved by the present acknowledgedly imperfect spraying methods. He did not believe it necessary to lay so much stress on filling the calyx, and was decidedly in favor of delivering the spray in as mistlike condition as possible. Excellent paying results were now being secured by ordinary farmers with the mist spray which has been used for several years." The contention is that if we can save 70% there is no use in trying for 100%.

"Mr. Quaintance pointed out that fruit-growing conditions in the Mississippi Valley and Eastern States were quite different from many sections of the West, such as Utah. The absence of rains there during the growing season largely obviated the necessity of fungicides. While he did not doubt that it was entirely practicable to use a coarse spray for the codling moth in Utah and thoroughly drench the trees, this would be a bad practice according to present ideas of spraying in the East, where a mist-like spray is desired to treat uniformly all parts of the foliage and fruit. Under present conditions of spraying, young apples are often russeted by the Bordeaux and arsenical treatment, especially by the one just after the petals have fallen, and a thorough drenching of the trees at this time would be likely to prove harmful in this way." Of course, it is harmful and expensive to drench the trees with Bordeaux mixture, and the conservative fruit grower feels that to apply the two mixtures separately is more trouble than the fruit crop is worth.

The editor of the Fruit Grower of St. Joseph, Missouri, in commenting on our methods of spraying in the January issue of that paper, thought it necessary to add that "Professor Melander's experiments were conducted in an irrigated country and therefore rains did not wash any of the poison from the foliage nor from the young fruit." It should be unnecessary to remind him and many others

that it rains in Washington as well as elsewhere. In fact, after the second spraying one year in the Yakima Valley three inches of rain fell in a few hours, yet where arsenate of lead was used there was no need of re-applying the spray. Last year we gave the first spraying of one orchard at Walla Walla in a hard wind and rain, yet with the same perfect results as elsewhere, for our spray at 200 pounds pressure penetrated below the stamens, while the rain did not.

Since 1901 the Illinois Experiment Station has been comparing high and low pressures and misty and coarse sprays in treating the codling moth. They conclude that "the application which was most effective in filling the calyx cavity was that made in the form of a fine mist by means of a Vermorel nozzle under high pressure." (Ill. Bull. 114, p. 383, 1907.) That may be true when it applies only to the *outer* calyx cavity, where the larvæ do not enter the apple. The fourth year of this experiment a pressure guage was secured for the pump, when it was discovered that the "high pressure was probably about eighty pounds."

Even so recent and authoritative a paper as Farmers' Bulletin 247 (1906), obviously written from office experience rather than acquaintance with field conditions, ignores arsenate of lead, advises a fine mist spray always, and suggests six sprayings for the codling moth. And yet when a Western Experiment Station asked for an Adam's fund project on the codling moth we are assured by the Office of Experiment Stations that the Bureau of Entomology advises "that the codling moth problem is solved."

Dr. Ball's paper evidently aroused interest at the New York meeting, for we now find in the second number of the new Journal of Economic Entomology a summary of an extended statistical experiment on the value of early sprayings in New Hampshire. This project was undertaken by Director E. D. Sanderson, and was an attempt to apply Western methods to Eastern conditions.

"Plot 1 was given the spraying immediately after the petals fell, with a fine mist. Plot 2 was sprayed at the same time with a Bordeaux nozzle and thoroughly drenched, the spray being applied at 100 pounds pressure. Neither of the plots were sprayed subsequently. This experiment was repeated under similar conditions in another orchard. There was but 2% or 3% difference in the results in both cases, in one orchard favoring the drenching and in the other favoring the mist, so that we are forced to the conclusion that there is very little difference in their effectiveness." . . . "Considering the total benefits for the season, it was found that spraying the calyx only may give a benefit of 62%," which is surprisingly low compared with Western results. The explanation, however, is clear

when we read that "careful examination of the calices by Dr. Headlee failed to show any spray lodged beneath the stamens or in the calyx cavity proper." An attempt was made to apply Western methods to Eastern conditions, that is to fill the lower calyx cup with poison as the best treatment for the codling moth, but the most essential point was neglected,—the spray was not shot *down* and was not put in the only place where it was needed.

All of which reminds me of the early troubles in the East over the sulphur-lime wash; how the impractical spraying of a couple of entomologists induced a neglect of a tried remedy, known to be completely effective on the Pacific coast, with a consequent ruin of millions of dollars of orchard property. Since, "in a second bulletin from the U. S. Department of Agriculture, the chemical reactions of the wash were set forth and it was shown almost conclusively that sulphur-lime could not reasonably be expected to be of much value in the moist East" (Bull. 37, p. 55, U. S. Bureau of Entomology). This neglect might have continued until today had not Dr. Forbes' experiment of washing off the spray with a pump and yet finding the scale dead, or the successes of a few practical fruit growers awakened official entomologists to the fact that something was wrong. This neglect of the sulphur-lime wash in the East has had an important economic bearing, since probably as much as any one factor it has been responsible for the transfer of interest in fruit growing from the East to the West.

Now, the purpose of this paper is not to antagonize Eastern entomologists, but to call attention to the fact that a most important field is still open for investigation. The success of careful filling of the calyx cup has been too universal in the far West to believe it is inapplicable elsewhere. If some Eastern entomologist will actually spray as we do in this region and give our methods the trial they deserve, the sole purpose of this article will have been accomplished. But an apathy to successful methods if continued will be detrimental to the profession of economic entomology, especially when the insects concerned are as prominent as the San José scale and the codling moth.

REPORT OF THE SIXTH ANNUAL MEETING OF THE AMERICAN ASSOCIATION OF HORTICULTURAL INSPECTORS

The sixth annual meeting of this association was held at the Windsor-Clifton Hotel, Chicago, Ill., December 27, 1907. Mr. A. F. Burgess, Washington, D. C., presided and Prof. James Troop, La-

fayette, Ind., secretary of the association, was also present. The following twenty-one states were represented by the official inspectors or deputy inspectors: Connecticut, Dr. W. E. Britton; Georgia, Mr. E. L. Worsham; Idaho, Mr. J. R. Field; Illinois, Dr. S. A. Forbes and Mr. J. A. West; Iowa, Prof. H. E. Summers; Kansas, Dr. T. J. Headlee; Louisiana, Prof. Wilmon Newell; Massachusetts, Dr. H. T. Fernald; Maryland, Prof. T. B. Symons; Michigan, Prof. L. R. Taft; Minnesota, Prof. F. L. Washburn; Nebraska, Prof. Lawrence Bruner; New Hampshire, Prof. E. D. Sanderson; New Jersey, Dr. J. B. Smith; New York, Mr. P. L. Heusted; North Carolina, Prof. Franklin Sherman, Jr.; Oklahoma, Prof. John F. Nicholson; Pennsylvania, Mr. E. B. Engle; Tennessee, Prof. H. A. Morgan and Prof. G. M. Bentley; Virginia, Prof. J. L. Phillips; West Virginia, Prof. W. E. Rumsey and Prof. Fred E. Brooks. Official entomologists not directly connected with horticultural inspection work were also present from Alabama, Delaware, Indiana, Maine, Missouri, Ohio and the District of Columbia. The American Association of Nurserymen was represented by its President, Mr. J. L. Hill of Des Moines, Iowa, Prof. John Craig, Ithaca, N. Y., Mr. Orlando Harrison, Berlin, Maryland, and Col. C. L. Watrous, Des Moines, Iowa.

A report was presented by Mr. Orlando Harrison, chairman of the joint committee on national law for the control of introduced insect pests, as follows:

"To the Members of the American Association of Horticultural Inspectors.

"GENTLEMEN: As chairman of the committee on uniform inspection of nursery stock for the American Association of Nurserymen appointed by our president at our last annual meeting, it is a pleasure to say that I sent out about 88 letters to various nurserymen and have received 60 replies, sufficient to indicate that they are desirous of some action being taken along the line of uniform inspection, and from the information gathered, it is safe to say that the majority of nurserymen welcome inspection by the entomologists or by competent assistants, and also by pathologists, and a better understanding is desired on the part of the nurserymen of what is expected of them.

"It was clearly shown in the correspondence which I received that the majority of our nurserymen desire a change in conflicting laws of the various states. They want one inspection, and one certificate which will permit them to ship into the various states.

"It is also clearly shown by their correspondence that something

must be done for their relief, as the excessive amount of red tape is expensive under present conditions.

"I am here to tell you that the nurserymen are anxious to coöperate with you in combating, controlling and stamping out, if possible, the insect pests and diseases that are liable to be found in the nursery. We realize that it is our duty to our customers, and to you horticultural inspectors, as our representatives who issue the certificates, that you be placed in the proper light with each other and with the grower in issuing these certificates from one state to another; but it does seem to us that more attention should be paid by the inspectors to neglected orchards near a nursery, and the various shade, ornamental and fruit trees commonly found in a city or small town near a nursery, and in making your demand on the nurseryman, a similar demand should be made upon the owners of such property. The nursery business is now already overtaxed and we desire coöperation with inspectors in causing such places to be treated or destroyed. We pray you not to overlook the other fellow, just across the fence, who is more dangerous to us than the man who would set fire to our buildings.

"I heartily join in the sentiments expressed by our President, Mr. Hill, this afternoon at the meeting of the entomologists, and my only desire is that you will all actively coöperate in bringing about the desired legislation.

"I would be pleased to see this association endorse the resolutions as presented to the Association of Economic Entomologists this afternoon. I thank you for the opportunity of presenting this matter before you, and hope for your earnest consideration of the same."

This committee also presented, through Dr. S. A. Forbes of Urbana, Ill., the following resolutions, which were the same as those endorsed by the Association of Economic Entomologists, and they were unanimously adopted:

A.—*Resolved*, That the Secretary of Agriculture should be empowered to make regulations governing importations liable to harbor insect pests or plant diseases; to require such importations to be accompanied by the certificate of a duly accredited entomologist of the country in which said shipments originate; or in the absence of such certificate, to make inspection of such shipments, by competent agents, at point of destination and that sufficient appropriation be made for this purpose by Congress.

B.—(1). That Congress be asked to enact a law empowering the Secretary of Agriculture to issue certificates of nursery inspection, as nearly uniform as possible, to all nurseries in the United States engaging in interstate trade, upon proper inspection of such nurseries by duly authorized representatives of the U. S. Dept. of Agriculture or by state officials approved by the Secretary of Agriculture for that purpose, and that sufficient appropriation be made therefor.

(2) That all state or territorial officials in charge of nursery inspection be urged to accept the certificates at their face value, and that in states where laws are now in force which will not allow the acceptance of such certificates, the inspection departments be requested to endeavor to secure such state legislation as will make this possible.

C.—That Congress should authorize the Secretary of Agriculture to proceed to exterminate or control imported insects or plant diseases, or any insect previously native to a restricted locality, but which may become migratory and threaten the whole country, whenever in his judgment such action is practicable, and that an appropriation be made for this purpose as a reserve fund for emergency use against any such pest which may arise.

D.—The joint committee proposes to have two bills prepared for introduction in Congress, one of these embracing the subject matter of sections A and B above, and the other embracing only the subject matter of Section C, and that if the passage of both measures be found impracticable or impossible, then all efforts be concentrated in the attempt to secure passage of the bill involving the certification and inspection of imports and the control of nursery stock shipments entering into interstate trade, as above outlined.

As the authors of papers to be presented at this meeting were absent, the questions for general discussion were considered as follows:

1. Is the method of dipping nursery stock in a contact insecticide as satisfactory as fumigation?

The discussion of this question brought out the fact that in the Northwestern states the dipping of nursery stock for destroying San José scale is considered an efficient remedy. No extensive experiments along this line were reported, showing that this method was more effective than fumigation. After general discussion the concensus of opinion was that fumigation was preferable, and that no harm would result to the trees if the work was properly done.

2. What further precautions, if any, than those employed now can be adopted to prevent the dissemination or injury caused by crown-gall?

This question was thoroughly discussed, but no better plan was proposed than the one now in general use, namely, the destruction of infested trees and plants.

3. What privileges shall be allowed in the purchase and sale of nursery stock known to be scaly by both purchaser and seller?

This question brought out a general discussion and exchange of views from many of the inspectors and entomologists present. The attitude taken on this matter seemed to depend largely on the local conditions. No definite action was taken by the association, but the prevailing sentiment indicated that it was unwise to allow the shipment of stock known to be infested.

The following officers were elected for the ensuing year: President, Prof. H. E. Summers, Ames, Iowa; Vice-President, Prof. F. L.

Washburn, St. Anthony Park, Minnesota; Secretary, Prof. T. B. Symons, College Park, Maryland.

The association then adjourned to meet in joint session with the Association of Economic Entomologists at 10 o'clock the following morning, when papers and discussions of special interest to both associations were presented. The report of the joint session is included in the annual report of the Association of Economic Entomologists.

JAMES TROOP, *Secretary.*

NATIONAL INSECTICIDE BILL

As intimated in the last number of the JOURNAL, measures looking toward the national control of insecticides and fungicides have been introduced into Congress; Senate Bill 6515 by Senator A. B. Kittredge of North Dakota, and House Bill 21318 by Hon. Frank A. Lowden of Illinois, which bills are practically identical. The Senate bill was referred to the Committee on Agriculture and Forestry, of which Senator H. C. Hansbrough is chairman, and the House bill has been referred to the Committee on Interstate Commerce, of which Hon. William P. Hepburn is chairman. Copies of the Senate bill have been sent to all leading members of the Association of Economic Entomologists, Experiment Station directors, official chemists, manufacturers and others interested in such legislation. From an extensive correspondence, it is very evident that there is a widespread sentiment among the leading manufacturers in favor of such legislation. Several minor amendments to the bills introduced are undoubtedly desirable.

It now seems probable that a conference between the manufacturers, chemists and entomologists will be held in the near future, at which time desirable amendments will be agreed upon. The chairman of your committee begs to request that the entomologists carefully scrutinize this measure and send him any definite suggestions as to desirable amendments. There seems no probability of the measure passing at this session of Congress, but it will undoubtedly be re-introduced next December, and it is urged that it be called to the attention of state and local fruit and truck growers' organizations, and others who would be interested in its passage, and that they be urged to follow the course of this legislation and aid it as much as possible. It seems that its passage will depend very largely upon how much public sentiment is shown in its favor, as we believe that there will not be any serious organized opposition.

E. DWIGHT SANDERSON,
Chairman, Committee on Proprietary Insecticides.

OBSERVATIONS ON THE GENUS CONTARINIA

By E. P. FELT, *Albany, N. Y.*

This genus is of economic importance, despite the fact that the insect Americans have hitherto known as *Diplosis* or *Contarinia tritici* Kirby can not be referred thereto. In passing, we wish to state that there is some question as to the identity of *Diplosis tritici*, and the writer would appreciate most thoroughly any assistance other entomologists could give in the way of securing additional material this season. Similarly, *Diplosis violicola* Coq., though a species of much importance to violet growers, can not be retained in this genus.

One of the best known members of the genus is *C. pyrivora* Riley, an insect which was brought into this country about 1877 and which has caused a large amount of injury to pear growers, particularly in Connecticut, New York and New Jersey. This importation is a very well marked form, differing so widely from American species that one antennal segment of the male is sufficient for its recognition. Careful comparisons between American-bred insects and others received from Europe have established the identity of the two beyond question. There is but one generation annually, the larvæ wintering in the ground in oval, silken cocoons, the adults appearing about the time pears are in bloom. According to Schmidberger, the eggs are deposited on the anthers of the closed blossom to the number of 10 or 12, and in warm weather hatch in about four days. The young larvæ develop rapidly, penetrating to the core and feeding upon the interior. The affected fruit becomes characteristically deformed. June rains cause it to crack and decay rapidly, thus allowing the larvæ to escape and enter the soil, imagoes developing the following spring.

The recent studies of Mr. C. R. Ball have shown that *Contarinia (Diplosis) sorghicola* Coq. may be responsible for the failure of sorghum to produce a full crop of seed in our southern states. This trouble, Mr. Ball states, has been variously attributed to fungi, insects and unfavorable meteorlogical conditions, such as excessive precipitation, high humidity, severe drought and hot winds. Mr. Ball's experiments showed that heads protected from the midge were uniformly fertile where the growth was normal, while those exposed during the first half of anthesis and then protected were sterile in the upper portion and well seeded below. Mr. Ball succeeded in rearing from 500 to 1,160 midges from each of several infested heads. He also reared a parasite from this insect referable to the genus *Aprostocetus*.

A widely distributed form in the eastern states, *Contarinia liriodendri* O. S., is responsible for a beautiful and characteristic blister gall upon the leaves of tulip, *Liriodendron*. The gall is a nearly circular, somewhat convex blister mine about 5 mm. in diameter. The dark brown center is surrounded by a light brown, irregular area which is slightly darker on its upper margin, the coloration of both surfaces being approximately the same. The partly developed gall has a dark brown, slightly elevated, circular central portion surrounded by pale green, which in turn is encircled by pale yellow, shading into pale green and that again into the color of the normal leaf tissue. This species was first reared by Mr. J. G. Jack and brief descriptions published of the gall, larva and adult in 1889. Mr. Jack's observations show that in the vicinity of Boston there are three or more generations annually, the broods so overlapping that some larvæ may be found at almost any time. He states that the first eggs are probably laid in the spring on the unfolding leaves, while the last larvæ attain full growth about the end of September. The transformations occur in the ground, the late appearing larvæ probably remaining unchanged till spring. This gall insect is so abundant in many places as to seriously affect the foliage of its food plant.

Contarinia ananassi Riley, originally described as *Cecidomyia cupressi-ananassi*, is another member of this genus, chiefly interesting because of the characteristic gall it produces on cypress twigs, *Taxodium distichum*. This gall is a pale brown, sparsely pruinose, ovate swelling on the twig some 1.25 cm. long and bearing numerous transverse, knife-edge-like elevations. This deformity is evidently an enlargement of the growing stem, the transverse elevations corresponding to the leaf scars. The normal fibers of the twig are easily detected in the central portion of the gall, which later may contain from three to eight larvæ in a spongy, golden brown mass. Adults were bred in May and there is probably but one generation annually.

The European *Contarinia rumicis* Low, was bred last July from reddish or brown seeds of curled dock, *Rumex crispus*, taken at Newport, N. Y. Professor Trail states, in the *Scottish Naturalist*, that this species also occurs in the swollen buds of sheep-sorrel, *Rumex acetosella*. This weed is abundant in our section of the country and it is somewhat surprising, if it has this habit in America, that we have not taken this species at large in our extensive collecting during the last two or three years.

Contarinia gossypii Felt is a species which has recently been brought to attention because of its injuring cotton in the British West Indies. No information is at hand as to the precise character of the damage.

Contarinia setigera Lintn. was bred a number of years ago by the late Doctor Lintner, from shoots of musk melon, the young leaves of which had been transformed into a small, irregular, subovate, downy gall, presumably made by this insect.

Contarinia negundifolia Felt MS. was reared from the leaves of box elder, *Negundo aceroides*, collected in Virginia by Mr. Theodore Pergande May 12, 1884. Mr. Pergande states that the larvæ deserted the galls May 15 and entered the ground, remaining there until the following spring. It is possible that this last named species may prove to be identical with *Cecidomyia negundinis* Gill., a species which has been recorded by Professor Gillette as being quite injurious to box elder trees on the college campus at Ames, Iowa. It has been impossible up to the present to obtain for comparison specimens of the last named form.

There are several other American species referable to this genus, some with unknown habits. *Contarinia perfoliata* Felt MS. was bred in August, 1907, from the florets of thoroughwort, *Eupatorium perfoliatum*. Another undescribed species, *Contarinia quercifolia* Felt MS., has been reared from oak, presumably in connection with a Cynipid gall, though we have no exact record in respect to the same. *Contarinia agrimoniae* Felt was reared in September, 1907, from yellowish larvæ in the florets of *Agrimonia eupatoria* taken at Bath, N. Y. *Contarinia virginianiae* Felt, originally described as *Cecidomyia*, was bred June 1 by Dr. James Fletcher, from the deformed fruit of *Prunus virginiana*. Another undescribed species, *Contarinia clematidis Felt* MS., has been reared from an irregular subglobular gall taken on clematis at Newport, N. Y., July 24, 1907.

The above shows that members of the genus *Contarinia*, as at present restricted, display a marked preference for florets, fruits or buds, *C. liriodendri* and *C. ananassi* being marked exceptions thereto, though the latter is more apparent than real, since the gall appears to be developed from the rapidly growing, more tender portion of the twig, which is consequently allied to floral and bud tissues noted above. There seems to be no rule as to the number of generations produced annually by members of this genus. A few forms at least breed throughout the season, while others, apparently limited by conditions presented by the food plant, have but one generation annually. This limitation of the number of generations by conditions of the food plant agrees with observations made upon better known species of the group, such as *Mayetiola destructor* Say.

JOURNAL OF ECONOMIC ENTOMOLOGY

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JUNE, 1908

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints of contributions may be obtained at cost. Minor line figures will be reproduced without charge, but the engraving of larger illustrations must be borne by contributors or the electrotypes supplied. The receipt of all papers will be acknowledged.—Eds.

The importance of accurate biological data cannot be questioned, despite the fact that all too frequently it is lacking in the case of some of our common destructive insects. Several years ago Mr. A. A. Girault commenced a series of tabulations of the number of eggs deposited by various species and, thanks to his activity, we have exact data relating to some nine species, the majority of them being of economic importance. These are by no means the only figures in this field, yet they indicate a line of productive activity. Our attention has recently been called to another series of exceedingly timely statistics, in view of the present great interest in parasitic insects. Mr. H. J. Quayle* states that the brown scale, *Eulecanium armeniacum*, is supposed to be controlled by its parasite, *Comys fusca*, its efficiency usually being estimated at 95%. Nevertheless, a statistical study of specimens from 66 different orchards shows a range from 1.9 to 60% in the number parasitized, the average being 12.2%. This study should be continued, as figures for one year are not conclusive. Mr. Quayle calls attention to the fact that other agents are responsible for the destruction of a number of the scale insects, and all too frequently these latter appear to be unnoticed. Parasites have deservedly received considerable attention and occasionally there is no doubt but what they may be responsible for the destruction of 95 or even a higher percentage of their hosts. There is an abundant opportunity for extensive studies of various parasites in order to establish beyond question their true value as natural checks. It is presumable that the work of importing parasites of the gipsy and brown-tail moths will give considerable additional information upon this phase of biological science. There is also great need of more extended information of this character respecting many of our native species.

* Science, May 15, 1908. 27:788-89.

Reviews

Third Annual Report of the Superintendent for Suppressing the Gipsy and Brown-tail Moths, by A. H. KIRKLAND, January, 1908, p. 1–228.

This report is a State document of more than ordinary interest, since it deals with two insect pests of national importance. The local authorities have concentrated their efforts upon keeping the insects in control in the residential sections, while agents of the Federal Bureau of Entomology have given special attention to trees along some 8,000 miles of streets and those overhanging railroads and other lines of travel. The special purpose of this latter line of work is to prevent further spread by means of automobiles. Mr. Kirkland reports a most hearty coöperation as a whole on the part of local officials and citizens. A feature of special interest to entomologists is the condensed data respecting the cost of spraying operations under varying conditions, together with observations upon the adaptability of various forms of spray outfits. The cost of application ranged from $36.25 per acre or approximately 76.3 cents per tree in a woodland consisting of pine and hard wood ranging from 30 to 50 feet in height, and where it was necessary to climb 80% of the trees, down to $2.46 per acre or 3 cents per tree in a woodland along a roadside, with the trees ranging from 20 to 60 feet in height. The first treatment was under adverse conditions, while in the second instance there were comparatively few hindrances. Obviously it will be necessary to continue extensive sprayings for several years at least, and an investigation of the best and most efficient methods is of utmost importance, particularly in woodlands. The report shows that woodlands present a serious problem owing to their low valuation and to the difficulties incidental to treatment. The desirability of more economical methods of fighting the pests in such situations is obvious to all familiar with the conditions. Some interesting data is given concerning the effect of spraying upon bird life, and also the danger to stock where large amounts of poison are applied, particularly with a coarse spray. The ability of the young gipsy moth caterpillars to live upon white pine has been the subject of careful investigations and the indications are that in woodlands where there is a considerable proportion of pine, important modifications in methods may be introduced and the insect controlled with a resultant large saving in the cost of control.

The importation of parasites has been vigorously pushed and a larger number and greater variety obtained than in any preceding year. Large numbers of parasitized individuals of both the gipsy moth and the brown-tail moth were received, the parasites reared and liberated under favorable conditions. This phase of the work has been aptly characterized by Mr. Lounsbury of South Africa as more important than any other feature. Fourteen species of Hymenoptera and twenty-four species of Diptera were bred from the material, several species being liberated in large numbers and some passing the winter of 1906–'07 in safety. Four species of predaceous beetles, two of Calosoma and two of Carabus, have been imported and one at least of the former has wintered in safety.

The most interesting portion of the report to American Entomologists is that part giving the conclusions of various specialists invited to inspect the

work of importing parasites. Representative entomologists, not only from America but from Europe, South Africa and even Australia, personally investigated the methods employed and all unanimously agreed in commending the work in all its phases most highly. There is, in all the reports, unqualified endorsement of the Superintendent for placing the execution of this work in the hands of Dr. L. O. Howard, Chief of the Bureau of Entomology. Furthermore, several have taken the pains to look into the proposition made several years ago by certain Western parties, and have unhesitatingly given a decision in favor of the work being conducted by the party now charged with its execution. Certain suggestions were made by various entomologists, such as further investigation of fungous diseases, the importance of the biological study of the various parasites, and in particular, the advisability of securing certain parasitic enemies of the gipsy moth known to exist in Japan. It is gratifying to state that the wisdom of most of these suggestions had been previously recognized and that steps have already been taken for the carrying out of some. This investigation by independent entomologists from widely separated localities should settle for all time any hostile criticism of the methods now employed. Ample funds should be made available for the work with parasites, because if it is worth doing at all it is worth doing thoroughly. No stone should be left unturned in the search for efficient enemies of these two destructive insects.

The report as a whole is most commendable, presenting a maximum of information in a minimum of space, and in a most accessible form. There seems to be but one omission, namely, some statement as to the territory now occupied by the brown-tail moth. E. P. F.

Seventh Report of the State Entomologist, by W. E. BRITTON. Report of the Connecticut Agricultural Experiment Station, 1907. Part 5, p. 265–338.

This report contains several valuable contributions. One on various gases for fumigating nursery trees, a summary of which was given before the Chicago meeting of the Economic Entomologists and is published on p. 110-12. The results of experiments with different brands of soluble or miscible oils are given, showing an efficiency varying from 95.7 to 100 per cent. There is a detailed, well illustrated account of the new peach sawfly, *Pamphilius persicum* MacG., an insect which may prove of considerable economic importance. The work of exterminating a small colony of gipsy moths is described in detail. Indications are that it will be successfully accomplished within the next two or three years. The recent enactment concerning this pest is also included. Chemical analyses of lead arsenate and Paris green, previously published as a bulletin, form a part of the report. Observations are also given on a number of species injurious during the year.

E. P. F.

The So-Called Grain Bug and Other Grain Aphids in Minnesota in 1907, by F. L. WASHBURN. Special Report of the State Entomologist of Minnesota, March, 1908, p. 1–21.

This special report gives a summarized account of the grain aphid, *Toxoptera graminum*. The differences between the various species are well brought

out by illustration as well as description. The author is to be congratulated upon having produced a most admirable account of this insect and its allies, the typography and illustrations being most excellent.

E. P. F.

Gipsy and Brown-tail Moths, by E. DWIGHT SANDERSON, N. H. Agricultural Experiment Station, Bull. 136, 1908, p. 93–156.

This bulletin gives the distribution of both species in New Hampshire. The gipsy moth occupies the southeastern corner of the State, while the brown-tail moth may be found over most of the southern third, having greatly extended its range. Excellent general accounts, with a number of original illustrations, are given of both species, together with the recently enacted law.

E. P. F.

Current Notes

Conducted by the Associate Editor

Mr. Z. P. Metcalf, Assistant Entomologist to the Michigan Agricultural Experiment Station, has been appointed Assistant Entomologist to the North Carolina State Board of Agriculture, and will enter upon his new duties June 20.

Mr. S. C. Clapp has been appointed Inspector of Nurseries and Orchards for the Division of Entomology of the North Carolina Department of Agriculture, to succeed Mr. L. M. Smith, resigned. Mr. Clapp is a native of North Carolina and has had considerable experience in general nursery and insecticide work.

Mr. Ed. Kinney has begun work as Assistant in Entomology and Botany at the Kentucky Agricultural Experiment Station. Mr. Kinney has been a student at the Ohio State University and will take the degree of Bachelor of Scientific Agriculture at the end of the present year.

Mr. C. F. Jackson, A. M., Assistant in Zoölogy and Entomology at the Ohio State University, has been elected Assistant to the Entomologist in the New Hampshire Agricultural Experiment Station.

Mr. N. E. Shaw, a graduate of the Ohio State University, who has previously been employed as an Assistant Inspector by the Ohio State Board of Agriculture, was elected Chief of the Division of Nursery and Orchard Inspection, and assumed his duties April 1. Mr. W. E. Evans, a graduate of the same institution, has been retained as first Assistant Inspector.

Mr. J. B. Parker, A. M., Ohio State University, has been elected Assistant Entomologist in the Kansas Agricultural Experiment Station, and took up the work May 1.

The summer session of the Lake Laboratory of the Ohio State Uni-

versity will open June 22. An excellent course in Entomology is offered and abundant opportunities are provided for research work. The Laboratory is located at Cedar Point, near Sandusky, Ohio. Full information concerning courses can be secured by writing to the Director, Prof. Herbert Osborn, Ohio State University, Columbus, Ohio.

Mr. A. C. Baker of the Agricultural College, Guelph, Ontario, Canada, has been appointed Assistant in Entomology at the Minnesota Agricultural Experiment Station.

Mr. L. M. Peairs, a graduate of the Kansas Agricultural College, has resigned as Assistant to the State Entomologist of Illinois and has accepted the position of Assistant Entomologist to the Maryland Agricultural Experiment Station.

Mr. Franklin G. Fox has resigned as Assistant in Apicultural Investigations in the Bureau of Entomology, Washington, D. C., and the position has been filled by the appointment of Mr. Arthur H. McCray, a member of the senior class at the Ohio State University.

Mr. R. W. Braucher, a graduate of the University of Illinois, has been appointed an Assistant in the Bureau of Entomology, and will be engaged in the investigation of deciduous fruit insects.

Mr. A. G. Hammer, a post-graduate student at Cornell University, has been appointed an Assistant in the Bureau of Entomology, and will work on deciduous fruit insects.

M. A. Vuillet, who is an Assistant to M. Rene Oberthur, at Rennes, France, has been secured by Dr. L. O. Howard to rear parasites of the gipsy and brown-tail moths at that place and forward them to the gipsy moth laboratory at Melrose Highlands, Mass., for distribution in the moth infested district.

Dr. Wm. M. Wheeler, Curator of Invertebrate Zoölogy in the American Museum of Natural History, has been appointed Professor of Economic Entomology in the Graduate School of Applied Science of Harvard University.

Mailed June 15, 1908.

with a membranous and semi-opaque shell, and 1.5 mm. long. He says in his report: "The cavity was lined with a reddish, glossy material, which seemed to be a thin skin, separable from the woody tissues. The sap was just beginning to run and the tissues were full of it."

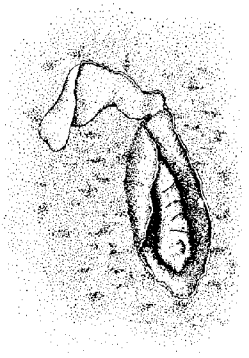

FIG. 6. Nymph of *Empoasca mali* within the pouch, the covering epidermis being turned back, much enlarged (original).

Of course, it yet remained to be proven that the above egg was that of *Empoasca*. No more eggs were found until May 24th, when Mr. R. L. Webster, in charge of the insectary and a part of the field work for the department during the summer, found them quite numerous in three-year old apple stock in a southern Minnesota nursery. He reports these eggs as being somewhat smaller than those found at St. Anthony Park, measuring .4 and .75 mm. Mr. Ainslie's description applies so well to the later found eggs that there is but little if any doubt of their being those of the same species. All these "blisters" or pouches containing eggs were found on old wood in the upper part of the trunk, and none on the small twigs, and their general shape varied from that of a fresh water mussel or clam shell to almost cylindrical.

A small tree showing a number of these blisters was taken into the insectary, and there a young *Empoasca* was observed in the act of emerging. This specimen died before becoming free from the blister. A sketch was made at the time by our artist, showing the bark cut back and the body of the larva below.

We cannot speak of the location of the summer egg with as much certainty as we can of the winter egg, although putting the evidence in our possession with that of others, we are inclined to the belief that the petiole and mid-rib, as well as the leaf itself, may be the places chosen for oviposition on the apple by the females of the summer generations, for Ainslie found on June 25th an enlargement on a petiole which contained the remnant of an egg shell, and on September 4th Webster found a swelling in a leaf similar to that which characterized the presence of the winter eggs. Only one was found. Webster describes it as 5 mm. long, slightly brown, with a slit in one end.

On September 19th in a large nursery, Mr. Ainslie examined a number of one year old apple trees. These trees were almost hidden in a

N. B.—Insert in place of pages 143, 144.

growth of buckwheat planted for winter protection. The plot had been infested with leaf hoppers earlier in the season, and a few were still in evidence. Every portion of the bark of several trees was examined most thoroughly with a hand lens without result, but on a few petioles slight discolorations, accompanied in each case by an elevation of the epidermis, were found. These were so small that they were hardly visible to the naked eye, and were for the most part located on the side of the petiole, and on the half nearest the leaf. One was found on the under side of the mid-rib. *Empoasca* larvæ were found on the above trees, and the spots on the petioles were, according to Ainslie, the only abnormal thing about the trees.

The buckwheat growing amongst these trees was also examined, and two similar discolored swellings found on petioles. At this date there were very few *Empoasca* on the trees, but they were numerous on the buckwheat. Dissection of some of this material on November 9, preserved in alcohol since September 19, and not in very good shape, disclosed nothing of which we can speak definitely.

While[1] we have found no actual proof, showing the location of the eggs of the summer broods, it seems probable that they are laid on leaf or petiole, as is the case with *Typhlocyba comes*. As if in corroboration of Dr. Forbes' observation, Mr. Webster found on the under side of an apple leaf a swelling similar to that in which the winter eggs were found on the bark. This was found September 4th, and was the only one discovered. The swelling was .5 mm. long, slightly brownish in color, with a slit in one end. I propose during the coming summer to obtain some light upon this phase of the subject, and also upon the date of egg laying by the last brood in the fall.

Insectary records of the stages of *Empoasca* show a record of from nineteen to twenty-five days as nymphs, and five nymphal stages between egg and adult. It was practically impossible for us to determine the length of each instar exactly, but it may be safely said that the first brood nymphs have longer instars than those in the following broods. The average lengths of individuals in the successive nymphal stages are as follows: First stage, .8mm.; second, 1.3 mm.; third, 1.7 mm.; fourth, 2.1 mm.; fifth, 2.4 mm., and the adult 3.1 mm.

Mr. Webster reports observing these hoppers hopping in the last nymphal stage, in several instances leaping a distance of over a foot.

[1] Owing to an unfortunate duplication of matter, pages 143 and 144 have been reprinted so they can be inserted in corrected form when binding the volume. Prof. Washburn kindly supplied the above paragraph to fill an awkward vacancy.